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Virtual reality (VR) treatments for anxiety disorders are unambiguously successful, so why are so few therapists using it? Barriers to adoption and potential solutions

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Abstract

Anxiety disorders are a significant cause of disability globally, yet only one in ten sufferers receives adequate quality treatment. Exposure-based therapies are effective in reducing symptoms associated with a number of anxiety disorders. However, few therapists use exposure techniques to treat these conditions, even when they are adequately trained in them, often because of concerns about provoking distress, drop out, logistical barriers, and other concerns. Virtual reality exposure therapy (VRET) can address many of these concerns, and a large body of research decisively shows that VRET is as efficacious for treating these conditions as in vivo exposures. Yet, use of VRET remains low. In this article, we discuss several factors we believe are contributing to low VRET adoption among therapists and raise potential solutions to address them. We consider steps that VR experience developers and researchers might take, such as leading studies of VRET's real-world effectiveness and treatment optimization trials and continuing to improve the fit of platforms with clinicians' workflows. We also discuss steps to address therapist reservations using aligned implementation strategies, as well as barriers for clinics, and the roles that professional organizations and payers could have in improving care by encouraging adoption of VRET.

Keywords

Virtual reality; anxiety; psychotherapy; exposure therapy; implementation; adoption

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Conflicts of Interest

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Introduction

Anxiety disorders are among the most common mental health disorders worldwide (Lépine, 2002; Michael et al., 2007) and are a significant source of health burden as the sixth leading cause of disability globally (Baxter et al., 2014). These disorders are also very responsive to available treatments (Barlow & Lehman, 1996; Bystritsky, 2006). Yet, less than a third of those suffering with anxiety disorders receive any treatment, and less than 10% receive treatment that could be considered of adequate quality (Alonso et al., 2018). Innovative ways of improving anxiety disorder treatment, access, and quality are clearly needed.

Psychotherapy is one of the most effective and durable treatment options available for almost all types of anxiety disorders (Bystritsky, 2006; Cuijpers et al., 2013). In turn, nearly all of the most effective approaches to psychotherapy across anxiety disorders involve some degree of exposure (Chorpita & Daleiden, 2009; Gunter & Whittal, 2010), and these exposures are likely responsible for much of the clinical benefit conferred by these treatments (Gould et al., 1997; Woody & Ollendick, 2006). Exposure techniques call for individuals to gradually confront fear-provoking stimuli to acquire new safety learning that contradicts their anxious beliefs about the dangerousness and intolerability of feared situations (Abramowitz et al., 2019; Craske et al., 2014; Rauch et al., 2012). Given the strong evidence base for exposure as an essential element of evidence-based practices (EBPs) for anxiety disorders, there have long been calls to prioritize the dissemination of exposure-based techniques in typical practice (McHugh & Barlow, 2010). Unfortunately, exposure-based treatments remain highly underutilized in typical practice. A survey of doctoral-level psychologists found that only 17% had used exposure techniques to treat patients with PTSD, despite up to 27% having been trained in using these techniques (Becker et al., 2004). Another study of doctoral and masters-level clinicians who provided outpatient psychotherapy for children with anxiety disorders showed that fewer than 5% of therapists had used exposure techniques to treat specific phobia (Whiteside et al., 2016). Past studies show that lack of training (Becker et al., 2004) and negative attitudes and beliefs about exposure-based therapies likely contribute to low use (e.g., that exposure therapies are dangerous or intolerable for patients, or that it is unethical; Pittig et al., 2019). Dissemination research has also consistently shown that, even with effective training, it is difficult to encourage therapists to adopt new techniques in general (Carroll, 2012; Edmunds et al., 2013). However, practical barriers are also a common reason for not using exposure techniques (Deacon & Farrell, 2013). For example, therapists who agreed that the planning and logistics of in vivo exposures took too much time and that they did not have access to feared places/situations were less likely to use exposure (Pittig et al., 2019). The time and effort involved in selecting, structuring, and replicating some feared situations could be especially challenging barriers, as well, particularly among newly trained therapists. Providing some exposures through virtual reality (VR) could help overcome some of these practical barriers, but a number of unique barriers have also limited its adoption to date.

Researchers have been exploring the use of VR systems to help conduct exposures in anxiety disorder treatment since the mid-1990s (Opdyke et al., 1995). VR refers to a computer-generated experience that provides an extensive, immersive, and vivid illusion of reality to human users (Slater & Wilbur, 1997). It creates this illusion by enabling

users to experience an environment as naturally as they would in the real world, and by providing realistic feedback across as many senses as possible as they do so (e.g., stereoscopic vision, adjusting the visual display in response to natural head movements, stereo sound, haptic feedback; Penn & Hout, 2018). The combination of multiple sensory inputs creates an illusion of *presence* in users, or a convincing sense that they are physically present in the digital environment (Riva et al., 2003). Exposures presented in VR generally involve gradually introducing the feared situation, place, or object to the user in the digital environment in a manner consistent with real-life, in-vivo exposures (Bush, 2008).

Meta-analyses have shown that VR-assisted exposure therapy (VRET) is as effective as in vivo exposures for specific phobias and has large effects versus waitlist and placebo conditions (Carl et al., 2019). Others have shown that treatments delivered through VR are as effective as Prolonged Exposure and other "active treatments" for posttraumatic stress disorder (PTSD), with large effects versus "inactive" control groups (Deng et al., 2019). Further, one meta-analysis showed that VRET is as effective as in vivo exposures for social anxiety at follow-ups collected soon after intervention, and that VRET again had very large effects versus waitlist controls (Horigome et al., 2020; Morina et al., 2023). Taken together, there is ample evidence that the effects of VR-delivered treatment generalize to improvement in symptoms across many anxiety disorders in real life (Deng et al., 2019; Morina et al., 2015) and that, for most, VRET use generally reduces symptoms about as much as in vivo exposure. We provide a summary of these effects in Table 1.

In our view, one of the most promising attributes of VRET is its potential to easily access certain feared stimuli and scenarios that are too difficult, costly, dangerous, or even impossible to re-create through in vivo exposures (e.g., combat, terrorism, flying; Mozgai et al., 2021). Whereas the most seasoned exposure therapists may have a more established repertoire of in vivo exposures they can easily use in many situations, VRET could be particularly helpful for overcoming these barriers among newer therapists, therapists less experienced in anxiety treatment, or therapists who are ambivalent about using exposure. VRET can simplify the task of planning and delivering exposures by curating a wide variety of feared stimuli or situations for therapists. It can allow therapists to control the timing and intensity of exposures and adjust them based on patients' progress or reactions (e.g., increasing or decreasing the intensity as needed) or to address unique fears (e.g., sitting in a middle seat on a flight). VRET could also enable therapists to deliver exposures more consistently and in ways that are optimally aligned with evidence-based protocols or that are associated with greater clinical benefit, such as delivering more intense exposures for a more prolonged period (Abramowitz et al., 2019). VRET could be a useful tool for helping patients engage in exposures outside of treatment as well, which is an essential component of treatment for promoting exposure skill generalization that patients often struggle to do independently. For these reasons, we believe that much of the promise of VRET is in providing therapists a tool that they can use to complement other approaches to exposure (in vivo, imaginal) that can encourage the use of exposure therapy even for feared objects/situations that have traditionally been challenging or impractical to replicate.

Until the last few years, one of the biggest barriers to the use of VR in psychotherapy was the absence of high quality, affordable, and practical VR hardware systems. However,

VR technology has advanced considerably in the last few years with several such systems entering the market. For example, Oculus Quest (Meta, Menlo Park, CA, $299-399) is a family of stand-alone head-mounted display (HMD) VR systems that do not require a tethered connection to a computer to use and that allow users to engage in experiences in either a custom “play” area (minimum recommended size is 6.5 ft. by 6.5 ft, per manufacturer) or in a stationary seated position. Unlike systems before it, which required active connections to computers and use of base stations that needed to be mounted in a specific room, platforms like the Quest enable VR use in places with limited space. Controllers also enable manipulation of objects in the virtual environment, and the system’s display can be broadcast to any TV or monitor with a wifi casting device (e.g., Google Cast) for observation. The Pico G2 and Neo (Pico Immersive Pte. Ltd., owned by ByteDance, Ltd., China) series HMDs have similar features as the Quest family, but are focused primarily on enterprise use and are priced slightly higher. However, both of these systems have enterprise versions, which offer developers a higher level of security and efficiency, although it is not yet clear whether either will pursue accreditations that would assure customers that they can securely handle health data (e.g., HITRUST; Microsoft, 2023). HTC VIVE (High Tech Computer (HTC) Corporation, Taiwan) also released an ultra-lightweight HMD in 2021 that is under 7 ounces and have a form similar to eyeglasses. However, this system must be tethered to an Android smartphone to work, which is also used as the platform’s controller.

With research coalescing around the effectiveness of VRET and technological barriers plummeting, why are so few therapists using it in practice? In this paper, we discuss key issues that could be impeding the uptake of VRET for anxiety treatment with the hope this creates a roadmap for future research exploring these hypotheses and further informs the development of strategies to encourage implementation and adoption of these treatments. Although others have discussed several key issues in this area (Boeldt et al., 2019), we believe a number of additional factors and potential solutions are relevant to the conversation. The sections below discuss barriers in the following areas: VR software products and research, clinicians and training, professional organizations, clinics, and cost. This article is not intended to be a systematic or exhaustive review. Rather, it is intended to identify and discuss important factors and considerations that could be the focus of future work. Similarly, while a growing literature has begun to evaluate whether some of the potential solutions we raise are indeed effective in addressing the barriers we discuss, these findings are complex and nuanced. Examining them in detail is beyond the scope of this manuscript.

Product Developers and Researchers

A handful of companies have developed platforms that enable therapists to select from libraries of potential scenarios and environments to use in exposure therapy. Some of these platforms have dashboards that allow therapists to select specific exposure scenarios, toggle their intensity and timing, and select whether specific stimuli occur if they are relevant to a given patients’ anxiety (e.g., whether a plane experiences turbulence). Several allow therapists to collect subjective ratings of anxiety from users during each experience and display these scores on a timeline of each exposure, and track users’ eye-movements,

enabling therapists to monitor whether patients may be trying to avoid engaging with feared stimuli within experiences (e.g., by looking at other things). These features are intended to make the platforms easy for therapists to use in practice and to provide easy access to tools to monitor patients' progress and adjust exposures to maximize their effectiveness. Although a few basic usability studies of the therapist interfaces of some platforms have been published (Brander et al., 2021; Brinkman et al., 2010; Gunawan et al., 2004; Helle et al., 2022), very little information is available about how well these platforms fare on important clinician implementation outcomes, like whether therapists find these platforms easy to navigate, personalize, and deploy *in-session with clients*, and whether they *like* these tools and actually use them when they are available. Focused studies on questions like these could help developers continue to improve the fit of their platforms with therapists' workflows, identify further improvements and areas of personalization that may be helpful, and help persuade clinics and other healthcare organizations that VRET protocols are worth the investment. Ample evidence suggests that conducting iterative tests with users to inform system design and improvement throughout the product's lifecycle can make them more effective and appealing (Landauer, 1997).

Additional evidence-based guidance about how VRET can be effectively integrated into exposure-based treatments could promote further uptake, as well. Although the number, sequence, timing, and duration of in vivo/imaginal exposures is relatively established for many exposure-based treatments, evidence-based guidance about how therapists might incorporate VR-assisted exposures into their practices, including as a compliment to other exposure methods, is more limited. Clinical trials comparing VRET to in-vivo exposures provide a general sense of the number of sessions that are likely to achieve a similar degree of benefit as *in vivo* exposures (i.e., the average total number of sessions in trials comparing VRET to in vivo exposures was nine in Carl et al., 2019). Exploring several other important questions relevant to VRET's use in practice could help provide additional guidance for therapists about how to incorporate VR in ways that achieve similar benefits for patients as traditional exposure-based treatments. For example, is each VR-assisted exposure equivalent to in vivo exposures of the same duration? Is it more beneficial to introduce exposure concepts using VR before graduating to in vivo exposures or vice versa? Several excellent books and manuals are available that describe how therapists might use VR with their patients, including detailed case examples, session descriptions, and checklists (Leaman et al., 2013; McMahon & Boeldt, 2021; Rothbaum et al., 1999). Although these resources are incredibly valuable, additional research exploring practical questions like these could further strengthen therapist's confidence in many everyday decisions about using VR with clients. As these guides recommend, carefully tracking patient outcomes within and across exposures and sessions can also help therapists make judgements about when and how to use VR based on the responses of individual patients. However, developing a clearer sense of an optimal protocol in practice could help therapists set reasonable expectations for treatment and increase treatment efficiency by reducing some uncertainty. Some evidence has suggested that therapists may have more positive views about evidence-based practices that clearly specify what content should be delivered in each session and in what order (Barnett et al., 2017), although other authors suggest training therapists in general principles over specific techniques or manuals (Abramowitz, 2006; Miller et al., 2004). In either case,

therapists will vary from existing standards for a variety of valid reasons, but additional research to develop a clearer understanding of what exposures to deliver, when, length of exposure for each condition, how to incorporate VRET alongside *in vivo* and other exposure techniques, and other practical questions, could help encourage further uptake of VRET.

Another limitation is that, while the evidence of VRET's efficacy in research settings is now strong, fewer studies are available on VRET's effectiveness in real world settings. "Voltage drop," or the tendency for the expected benefits of a treatment for a given patient to decrease as the treatment is applied to increasingly complex settings and diverse patients, is a well-established phenomenon in psychotherapy (Chambers et al., 2013). "Program drift," which involves a tendency for a treatment to show more limited benefits as therapists deliver it in the real world and deviate from its essential components, is also frequently a challenge to real-world delivery of standardized treatments (Chambers et al., 2013; Waller & Turner, 2016). Demonstrating that VRET improves outcomes among more heterogenous samples of patients as they receive care from different providers with varying levels of training in the complex environments of operating mental health clinics is critical for establishing VRET's potential impact on the health and well-being of real patients. Overall, this landscape suggests that product developers and researchers could encourage further adoption of VR-assisted psychotherapies by continuing to incorporate enhancements that improve the fit of available software platforms with therapists' workflows, and by facilitating research to identify specific principles or protocols for VRET use, address therapist implementation issues, and examine VRET's real-world effectiveness.

Finally, a related barrier that researchers and product developers may need to address involves determining how VR-assisted therapies can be delivered in the context of telemedicine. The COVID19 pandemic accelerated the use of telemedicine to deliver psychotherapy for many therapist and patients (Betancourt et al., 2020), and although many therapists have now returned to providing at least some care face-to-face, use of telemedicine remains high (Palma, 2021; Shklarski et al., 2021). Using VRET in psychotherapy delivered *entirely* via telemedicine would be challenging, given that most VRET products were developed specifically for use in face-to-face contexts where therapists can easily orient patients to VR, provide guidance as they are using it, and adjust the experience as needed while patients are using it. One existing guide to VRET similarly suggests that delivering VRET via telehealth is generally possible, but adds that it is mostly feasible with clients who already own the same requisite hardware systems and notes that not all software platforms enable remote delivery (McMahon & Boeldt, 2021). The authors additionally emphasize the benefits of delivering VRET in-person. We believe is likely that care will increasingly be delivered via a mixture of telemedicine-based and face-to-face sessions (a "hybrid" approach), rather than exclusively one or the other (Uscher-Pines et al., 2020). If so, this would allow therapists the opportunity to orient patients to VR and help them practice using it in face-to-face sessions. Clinics and therapists could then explore whether it is feasible to loan VR hardware systems to patients for use in subsequent sessions conducted over videoconference. Other approaches could potentially involve delivering *all* psychotherapy sessions in VR, rather than using videoconferencing, as some are exploring (Businesswire, 2021; Usmani et al., 2022). Regardless of the specific approach used, therapists will need specific guidance on best practices for delivering VRET

in the context of telemedicine. Although some companies have begun to offer cursory advice for therapists in this regard, dedicated research should explore the most promising ways of delivering VRET via telemedicine that best promote patient adherence and preserve the effectiveness of the techniques involved. At least some of the proposed solutions to delivering VRET via telemedicine so far also raise at least some additional barriers, such as increased costs and logistics related to managing, loaning, and recovering hardware systems for multiple patients at a time. If telemedicine continues to be a popular mode for delivering psychotherapy into the future, research dedicated to understanding these unique barriers, developing strategies to address them, and evaluating the effectiveness of these strategies will be needed. It is important to note, however, that the challenges to adjusting to telemedicine are not unique to VRET; telemedicine also presents unique and shared challenges for the delivery of *in vivo* exposure techniques, as well, although there is a much larger body of literature available on this topic (Gros et al., 2013).

Therapists and Training

As previously noted, many important therapist factors hindering the adoption of VR involve concerns and practical barriers to using empirically supported treatments or exposure techniques more generally. However, other therapist barriers are likely unique to VR. Hesitation about their capacity to effectively and smoothly use new technologies in general (Feijt et al., 2018; Muir et al., 2020) and VR systems specifically (Glegg et al., 2013) may contribute to low adoption of VR. Skepticism about its realism and efficacy is likely to play an important role, as well (Lindner et al., 2019). There is some evidence that therapist's general attitudes toward VR may improve somewhat after trying VRET (Rimer et al., 2021). Interactive trainings that involve demonstrations and two-way communication, whether delivered face-to-face or remotely, should presumably increase therapists' confidence with VR, especially relative to manuals and other passive training materials (Gallo & Barlow, 2012). While this might encourage VR use among counselors with reservations related to the technology (e.g., low confidence in their ability to use it, skepticism about its realism), it would not necessarily address reservations about exposure techniques themselves. Research has begun to explore optimal ways of providing training and changing therapist attitudes about both exposure therapy and VR (Farrell et al., 2016; Frank et al., 2020), but conducting demonstrations to give therapists first-hand experience with VR and countering specific negative attitudes about VR could be promising strategies for encouraging more adoption.

Another important therapist factor that likely contributes to underutilization is that psychotherapy as a field is slow to adopt innovations in general. Although the gap between research and practice is well-known in many areas of healthcare, the divide between scientifically-established best practices and the care being delivered in community settings seems to be uniquely wide in psychotherapy (Marinelli-Casey et al., 2002; Miller et al., 2006). Despite clear evidence of the benefits of adopting evidence-based practices for patients (Cukrowicz et al., 2011; Weisz et al., 2006), many therapists instead opt to rely primarily on their clinical judgement (e.g., Stewart & Chambless, 2007; Von Ranson et al., 2013). Similarly, in a 2014 study of Canadian psychologists, only 12% reported monitoring their patients' progress while in psychotherapy (Ionita & Fitzpatrick, 2014), even though meta-analyses have clearly established the value of outcome measurement in improving care

(de Jong et al., 2021; Lambert et al., 2018). Again, negative attitudes about evidence-based practices in general could play an important role (Aarons, 2004). One study reported that therapists were hesitant to adopt innovations like empirically supported treatments (ESTs) because they believed they lacked warmth and humanity, they did not have sufficient training, and because of the cost of materials (e.g., manuals, assessments; Pagoto et al., 2007). Many of the same attitudes could also apply to VR-assisted treatments. Despite this overall slow rate of diffusion, other research has found that therapists were more likely to adopt new treatment approaches when a significant mentor championed it with them (Cook et al., 2009), suggesting that training influential practitioners in VR-assisted therapies who, in turn, provide training to their colleagues could be one strategy to improve adoption (Moore et al., 2004; Yarber et al., 2015). Additionally, almost half of therapists in this study reported being more likely to use a new treatment if they had been trained on it while in graduate school (Cook et al., 2009), so incorporating VR-assisted therapies into both core curriculum and experiential learning experiences (e.g., departmental clinics) in graduate clinical training programs could translate into more widespread use of VR once these clinicians begin practicing independently (Chung et al., 2022).

Clinics

Clinics and workplaces also play an important role in facilitating or hindering adoption of VR-assisted psychotherapy for anxiety disorders. Research has affirmed the importance of organizational factors in determining therapists' use of specific treatment approaches and techniques (Aarons et al., 2012; Beidas et al., 2015; Glisson, Landsverk, et al., 2008). For example, the proficiency of the clinicians that make up an organization, the rigidity of the culture of the organization and specific departments (e.g., information technology), and the organization's resistance to change have been shown to affect the adoption and sustainability of new psychotherapies and programs (Glisson, Schoenwald, et al., 2008; Patterson et al., 2013). However, healthcare organizations that are 'fast movers' in terms of adopting new innovations could realize more revenue growth than those who are slower to adopt (Harvard Business Review, 2014). This may be partly due to these organizations attracting new patients explicitly seeking these care innovations (Accenture, 2013).

Beyond cost, one of the largest barriers to adoption of new technologies in mental health clinics generally has been concerns about confidentiality and data security. For example, one study showed that, after one clinic adopted an electronic health record system (EHR), nearly two-thirds of its clinicians were unwilling to record confidential information in it because of these concerns (Salomon et al., 2010). Similarly, 90% of psychologists expressed concerns about confidentiality when considering whether to use telehealth (Perle et al., 2014). Yet, today, these technologies are routine in many clinics. While a variety of factors have played a role in this shift (e.g., legislation, a global pandemic), achieving this level of penetration required clinics to address both real and perceived concerns about confidentiality and data security. For many, addressing these challenges has likely involved a mix of doing due diligence to source platforms that are compliant with various security standards and laws, educating staff clinicians about security controls, and changing the organizational culture to accept some degree of risk in order to better serve patients and meet their expectations (Ash & Bates, 2005).

Similar issues will need to be addressed for VR to realize more adoption, as well. For example, some VR platforms lack security accreditations or guidance despite prompting therapists to enter personally identifiable information (PII) about patients to help monitor their progress within the platform. Although entering this information is not required to use most platforms, it is likely that therapists may enter PII anyway simply because the platform allows it (even if they are explicitly instructed not to), posing a real but avoidable risk. As such, the lack of clarity around these concerns is likely a significant, real barrier to more widespread adoption among clinics and behavioral healthcare organizations. Another similar challenge that is unique to VR is low trust in the parent companies of some of the most popular VR hardware systems (e.g., Meta for the Oculus Quest system, and ByteDance for the Pico G2 system, which is a Chinese company that also owns TikTok). Although it is possible for clinics to navigate these issues in order to provide VR services, doing so is complicated and burdensome. Developers can assist by providing clearer guidance to therapists and clinics. Clinics who have successfully implemented VR could also provide instructive lessons for others about the most promising ways to manage these issues.

Professional Organizations

Today, the available evidence supporting VR's use for particular anxiety disorders, including specific phobia, PTSD, and social phobia, is strong. Meta-analyses have evaluated the effects of VR-assisted therapy versus in-vivo therapy and waitlist controls for each of these conditions (see Table 1). Across all conditions, these meta-analyses found that multiple randomized controlled trials showed that VR-assisted therapy significantly outperformed waitlist controls and was roughly equivalent to in vivo treatments. Using established criteria for determining the level of evidence supporting a given treatment (Southam-Gerow & Prinstein, 2014), we believe these studies demonstrate that VR-assisted treatments for these conditions should meet the criteria of a well-established treatment.

Treatment guidelines published by professional associations of therapists and other interest groups help therapists decide which treatments to deliver and can guide patients in requesting specific treatments when seeking services. These guidelines summarize the existing scientific evidence on available treatments for a given condition, make recommendations about which treatment approaches might provide the most benefit for patients, and provide guidance about the best ways to deliver them (Steinberg et al., 2011). Despite their strong endorsement of in vivo exposure techniques, however, we are not aware of any organization or clinical practice guideline that has explicitly recommended using VR in psychotherapy for anxiety disorders, despite the robust evidence of efficacy. For example, in the American Psychological Association (APA) Society of Clinical Psychology (APA Division 12) guidelines on effective treatments for specific phobias, exposure therapies are described as having "strong research support," while VRET is described as needing "more studies … in order to demonstrate its efficacy for a broader range of phobia subtypes" (APA Division 12, 2018). The Anxiety Disorders Association of Canada's (ADAC) clinical practice guidelines for management of anxiety disorders, published in 2014, provides similarly tepid recommendations, suggesting that VRET "can be effective" for specific phobias (Katzman et al., 2014). Others do not mention VR at all (Anxiety & Depression Association of America, 2015; Department of Veterans Affairs & Department of Defense,

2017). Clinical practice guidelines have limitations (Courtois & Brown, 2019; Silver & Levant, 2019), but they are undoubtedly important in shaping the practices of therapists and conferring legitimacy to promising new treatments. As such, given that evidence supporting VR appears to meet the standard of a "well established" approach, we believe treatment guidelines for relevant anxiety disorders should be revised to include stronger support for the use of VR as an adjunct to exposure-based therapies. Doing so could be another important step that promotes uptake among clinicians.

Cost and Revenue Strategies

Taking the steps discussed in previous sections would help ensure that VR-assisted psychotherapy platforms are easier for therapists to use, and that they are aware of these platforms, have the tools to deliver them confidently, and trust that they can help patients, even in real-world conditions. However, the cost of purchasing VR hardware, licensing a software platform, and accessing ongoing training, maintenance, and support continues to be a key barrier to wider adoption (Chung et al., 2022; Lindner et al., 2019; Wray & Emery, 2022). Although the price of VR hardware has declined considerably in the last several years, the cost of purchasing or licensing software that enables the delivery of exposures ranges anywhere from $3,000 for a single-user perpetual license for a specific class of experiences (e.g., anxiety disorders) to $3,600 for an annual subscription that enables access to a variety of types of experiences. Discussing all possible strategies for addressing this barrier is beyond the scope of both this commentary (and our expertise), but the changing landscape of digital health products and healthcare payment models more generally raises some innovative possibilities for addressing cost barriers. At present, the primary revenue model for most VR-assisted psychotherapy products involves direct sales to therapists and clinics, either as a monthly subscription or a perpetual license. This approach is reasonable, given that it bears some similarity to revenue models that are used for medical devices. That is, like medical devices, VR-assisted psychotherapy is a technology that is intended for use within an existing billable service (i.e., psychotherapy sessions) to enhance the effectiveness of the service. Operating on a sale of product or licensing model allows healthcare organizations and clinicians to evaluate the potential value of the product, and if supportive, license it or purchase it outright (Ventola, 2008). In behavioral healthcare, one general challenge is that budgets for clinical tools, like assessments and intervention supports (e.g., VR), can be quite limited relative to other disciplines that are more accustomed to these expenses (e.g., optometry, dermatology). However, another challenge is that the most effective path to helping providers recoup the costs of VR is not yet clear. We believe identifying strategies to help providers successfully recover these costs is essential to realizing higher rates of adoption. A variety of paths could help achieve this and may be worth exploring, including strategies that help providers charge higher fees for VR-enhanced services, attract more patients, or eventually, receive quality incentives. First, although there are no specific billing codes available for VR-assisted psychotherapy, some VR companies have partnered with consultants to train providers who subscribe to their platform about billing strategies that could help them increase the amounts they are reimbursed for providing VR-assisted psychotherapy. These trainings include advice on

specific billing codes and rates they can use for providing VR-assisted services, as well as general tips to help therapists bill for all of the services they provide.

Some VR companies have also pursued strategies to help providers recover costs by helping them attract more new patients. One such strategy involves helping providers and clinics market their use of VR-assisted psychotherapy to potential patients. Although most consumers are probably unfamiliar with the benefits of VR-assisted psychotherapy for anxiety disorders, marketing campaigns could educate consumers about its potential benefits, just as many other medical and pharmaceutical products do. These campaigns could also help shape public perceptions of providers and clinics that offer VR services as particularly innovative. Recognizing this, one VR company currently provides marketing kits to therapists who purchase a license for their platform. The kit includes general tips on advertising, as well as a variety of content that providers can use for marketing their use of VR services on email or print materials, websites, and social media. As we show in our case study (Table 2), therapists who have adopted VR and took even passive marketing steps (e.g., listing it as a service on their website) report having been contacted by new patients who specifically request VR-assisted therapy. Considering other, similar ways of helping providers attract new patients could be an effective way of aiding them in recovering the cost of VR.

Other potential strategies could involve pursuing one or more of the alterative payment and delivery models that are increasingly building momentum, such as value-based care or pay-for-performance models (Carlo et al., 2020). These models often involve urging providers to adopt various evidence- and measurement-based care practices by providing incentives for implementing them and/or showing improvement in certain clinical measures among their patients, like reduced re-admissions and hospitalizations or improving follow-up after discharge (Carlo et al., 2020; Zhu et al., 2020). Although the vast majority of payers still use fee-for-service payment models for behavioral healthcare, in the last few years, a number of initiatives have been established to assist behavioral healthcare systems in participating in value-based care models with significant success (Center for Health Care Strategies Inc. & National Council for Behavioral Health, 2020). If behavioral healthcare systems participated in performance or quality programs that provided incentives for delivering evidence-based techniques more often, for example, adopting VR could ultimately be an effective way of encouraging therapists to use these techniques more frequently, thereby earning more quality incentives that might help recover VR's costs. Some medical device businesses have also been pursuing value-based contracting, in which the fees they collect for a device or service are tied to patient outcomes or other realized benefits (Aitken & Nass, 2021). VR platforms could consider similar value-based payment models, such as structuring their fees so that therapists pay on a per-member-per-month basis, or based on how well important clinical benchmarks are met or how much clinical improvement each patient achieves (e.g., improvement in functioning). In summary, there are a variety of possible strategies that VR businesses, clinics, and therapists could pursue, now and in the future, to help overcome the barriers to purchasing VR hardware and software, but it is not yet clear which paths might be most effective in reducing financial barriers to uptake. Given that it is unlikely that VR will achieve widespread adoption without addressing cost barriers, we believe it is critical

for developers, healthcare systems, and payers to develop clear strategies that help providers successfully recover the costs of VR.

Limitations

The evidence clearly shows that VR could be a powerful tool in therapists' toolboxes; one that enables them to deliver techniques that help those with a range of anxiety disorders more often and more easily. Like all other tools, though, VR currently has a limited set of applications for which there is convincing evidence. VR is not a "magic bullet" and it is not the right fit for all patients. "Simulator sickness" or "cybersickness," a condition similar to motion sickness in which patients experience dizziness, headache, blurred vision, and nausea/vomiting after using VR, is also a problem for some users (Saredakis et al., 2019). However, this was much more common with older systems that had dated technology and incorporated fewer ergonomic elements (e.g., inappropriate acceleration speeds, no independent visual background, poorer refresh rates, etc.) (Birckhead et al., 2019; Budhiraja et al., 2017; Gavgani et al., 2017; Yao et al., 2014). Many of these limitations have been addressed in head-mounted display systems that are commercially available today. Studies suggest that about 0.4% of all users report some symptoms of simulator sickness in these modern systems (Kourtesis et al., 2019), compared to up to 7% in older studies (Ruddle, 2004). In addition, Kourtesis and colleagues (2019) found that, among those who experience simulator sickness, symptoms usually peak after 11–20 minutes of use, and dissipate quickly after discontinuation. Together, these findings suggest that the durations of VR use that are required for implementation with anxiety treatment could be sufficient to cause symptoms of simulator sickness in a small minority of patients, but that removing the headset should allow symptoms to resolve relatively quickly. Screening patients for a history of motion sickness prior to use (Girard et al., 2009; Gold et al., 2006) and periodically checking in with them during use may help clinicians manage patient discomfort.

Discussion

Along with telehealth and electronic health records, VR-assisted psychotherapy has the potential to be among the first few standout examples of how digital health products can help enhance mental health care. Yet, a number of persistent barriers, many of which reflect broader struggles affecting the field more generally, continue to limit its use. In this perspective paper, we raised several issues that we believe are particularly vital to address to increase uptake of VR among therapists, but that have so far received limited attention. We also noted some areas of future research and potential solutions that might address these issues. A brief summary of these barriers, potential solutions, and future research directions are presented in Table 3.

Despite these challenges, a relatively small subset of particularly early adopting clinics and private practice therapists have successfully adopted VR for anxiety disorders and are actively using it with patients. In Table 2, we provide a case study to illustrate how one therapist navigated many of the steps involved in implementing VR-assisted therapy into their practice. This case study also highlights many of the ongoing challenges to

encouraging further adoption and sustaining VR use in therapy that we have highlighted in this paper.

Overall, we hope that this perspective serves as a helpful roadmap that facilitates more deliberate efforts to encourage use of VR in psychotherapy for anxiety disorders, and guides more focused implementation and dissemination research aimed at developing strategies to address the most persistent barriers. VR-assisted psychotherapy has considerable potential for improving care for several other mental health conditions, as well (e.g., eating disorders, substance use disorders; De Carvalho et al., 2017; Segawa et al., 2020), but that potential is unlikely to be realized so long as these shared barriers to adoption remain unaddressed. Overcoming these barriers in the context of anxiety disorder treatment, one of the most mature and well-supported applications of VR-assisted psychotherapies so far, would help clear a path for these other applications to realistically envisage being used in practice, where they can actually improve patients' lives. We believe doing so is critical, given the considerable impact these tools could have on the health and well-being of real patients.

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References

Aarons GA (2004). Mental health provider attitudes toward adoption of evidence-based practice: The Evidence-Based Practice Attitude Scale (EBPAS). Mental health services research, 6(2), 61–74. [PubMed: 15224451]

Aarons GA, Glisson C, Green PD, Hoagwood K, Kelleher KJ, Landsverk JA, & The Research Network on Youth Mental, H. (2012). The organizational social context of mental health services and clinician attitudes toward evidence-based practice: a United States national study. Implementation Science, 7(1), 56. 10.1186/1748-5908-7-56 [PubMed: 22726759]

Abramowitz JS (2006). Toward a Functional Analytic Approach to Psychologically Complex Patients: A Comment on Ruscio and Holohan (2006)

Abramowitz JS, Deacon BJ, & Whiteside SP (2019). Exposure therapy for anxiety: Principles and practice Guilford Publications.

Accenture. (2013). More than forty percent of U.S. consumers willing to switch physicians to gain access to electronic medical records, according to Accenture survey Retrieved January 20 from https://newsroom.accenture.com/news/more-than-40-percent-of-us-consumers-willing-to-switch-physicians-to-gain-online-access-to-electronic-medical-records-according-to-accenture-survey.htm

Aitken M, & Nass D (2021). Digital health trends 2021: Innovation, evidence, regulation, and adoption IQVIA Institute. Retrieved January 2 from https://www.iqvia.com/insights/the-iqvia-institute/reports/digital-health-trends-2021

Alonso J, Liu Z, Evans-Lacko S, Sadikova E, Sampson N, Chatterji S, … W. H. O. World Mental Health Survey Collaborators. (2018). Treatment gap for anxiety disorders is global: Results of the World Mental Health Surveys in 21 countries. Depression and anxiety, 35(3), 195–208. 10.1002/da.22711 [PubMed: 29356216]

American Psychological Association Division 12. (2018). Exposure therapies for specific phobias Retrieved January 31 from https://div12.org/treatment/exposure-therapies-for-specific-phobias/

Anxiety & Depression Association of America. (2015). Clinical Practice Review for Social Anxiety Disorder Retrieved September 13 from https://adaa.org/resources-professionals/clinical-practice-review-social-anxiety

Ash JS, & Bates DW (2005). Factors and forces affecting EHR system adoption: report of a 2004 ACMI discussion. Journal of the American Medical Informatics Association, 12(1), 8–12. [PubMed: 15492027]

Barlow DH, & Lehman CL (1996). Advances in the psychosocial treatment of anxiety disorders: Implications for national health care. Archives of General Psychiatry, 53(8), 727–735. [PubMed: 8694686]

Barnett M, Brookman-Frazee L, Regan J, Saifan D, Stadnick N, & Lau A (2017). How intervention and implementation characteristics relate to community therapists' attitudes toward evidence-based practices: A mixed methods study. Administration and Policy in Mental Health and Mental Health Services Research, 44(6), 824–837. [PubMed: 28236076]

Baxter AJ, Vos T, Scott KM, Ferrari AJ, & Whiteford HA (2014). The global burden of anxiety disorders in 2010. Psychological medicine, 44(11), 2363–2374. [PubMed: 24451993]

Becker CB, Zayfert C, & Anderson E (2004). A survey of psychologists' attitudes towards and utilization of exposure therapy for PTSD. Behaviour Research and Therapy, 42(3), 277–292. 10.1016/S0005-7967(03)00138-4 [PubMed: 14975770]

Beidas RS, Marcus S, Aarons GA, Hoagwood KE, Schoenwald S, Evans AC, … Walsh LM (2015). Predictors of community therapists' use of therapy techniques in a large public mental health system. JAMA pediatrics, 169(4), 374–382. [PubMed: 25686473]

Betancourt JA, Rosenberg MA, Zevallos A, Brown JR, & Mileski M (2020). The impact of COVID-19 on telemedicine utilization across multiple service lines in the United States. Healthcare,

Birckhead B, Khalil C, Liu X, Conovitz S, Rizzo A, Danovitch I, … Spiegel B (2019). Recommendations for methodology of virtual reality clinical trials in health care by an international working group: iterative study. JMIR mental health, 6(1), e11973. [PubMed: 30702436]

Boeldt D, McMahon E, McFaul M, & Greenleaf W (2019). Using virtual reality exposure therapy to enhance treatment of anxiety disorders: identifying areas of clinical adoption and potential obstacles. Frontiers in psychiatry, 10, 773. [PubMed: 31708821]

Brander M, Egger ST, Hürlimann N, Seifritz E, Sumner RW, Vetter S, & Magnenat S (2021). Virtual Reality Human–Human Interface to Deliver Psychotherapy to People Experiencing Auditory Verbal Hallucinations: Development and Usability Study [Original Paper]. JMIR Serious Games, 9(2), e26820. 10.2196/26820 [PubMed: 33769295]

Brinkman W-P, Van der Mast C, Sandino G, Gunawan LT, & Emmelkamp PM (2010). The therapist user interface of a virtual reality exposure therapy system in the treatment of fear of flying. Interacting with computers, 22(4), 299–310.

Budhiraja P, Miller MR, Modi AK, & Forsyth D (2017). Rotation blurring: use of artificial blurring to reduce cybersickness in virtual reality first person shooters. arXiv preprint arXiv:1710.02599

Bush J (2008). Viability of virtual reality exposure therapy as a treatment alternative. Computers in Human Behavior, 24(3), 1032–1040.

Businesswire. (2021). Revitalist to develop Revitaland - Virtual clinics in the metaverse Retrieved February 2 from https://www.businesswire.com/news/home/20211112005581/en/Revitalist-to-Develop-Revitaland-Virtual-Clinics-in-the-Metaverse

Bystritsky A (2006). Treatment-resistant anxiety disorders. Molecular psychiatry, 11(9), 805–814. [PubMed: 16847460]

Carl E, Stein AT, Levihn-Coon A, Pogue JR, Rothbaum B, Emmelkamp P, … Powers MB (2019). Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials. Journal of Anxiety Disorders, 61, 27–36. 10.1016/j.janxdis.2018.08.003 [PubMed: 30287083]

Carlo AD, Benson NM, Chu F, & Busch AB (2020). Association of alternative payment and delivery models with outcomes for mental health and substance use disorders: a systematic review. JAMA network open, 3(7), e207401–e207401. [PubMed: 32701157]

Carroll KM (2012). Dissemination of evidence-based practices: How far we've come, and how much further we've got to go

Center for Health Care Strategies Inc., & National Council for Behavioral Health. (2020). *Behavioral health provider participation in medicaid value-*

based payment models: An environmental scan and policy considerations. Retrieved January 2 from https://www.thenationalcouncil.org/wp-content/uploads/2020/03/Behavioral-Health-Provider-Participation-in-Medicaid-Value-based-Payment-Models-An-Environmental-Scan-and-Policy-Considerations.pdf?daf=375ateTbd56

Chambers DA, Glasgow RE, & Stange KC (2013). The dynamic sustainability framework: addressing the paradox of sustainment amid ongoing change. Implementation Science, 8(1), 117. 10.1186/1748-5908-8-117 [PubMed: 24088228]

Chorpita BF, & Daleiden ELJJ o. c. (2009). Mapping evidence-based treatments for children and adolescents: application of the distillation and matching model to 615 treatments from 322 randomized trials. Journal of consulting clinical Psychology Review, 77(3), 566–579. 10.1037/a0014565

Chung OS, Johnson AM, Dowling NL, Robinson T, Yucel M, & Segrave RA (2022). Are Australian mental health services ready for therapeutic virtual reality? An investigation of knowledge, attitudes, implementation barriers and enablers. Frontiers in psychiatry, 80.

Cook JM, Schnurr PP, Biyanova T, & Coyne JC (2009). Apples don't fall far from the tree: Influences on psychotherapists' adoption and sustained use of new therapies. Psychiatric Services, 60(5), 671–676. [PubMed: 19411356]

Courtois CA, & Brown LS (2019). Guideline orthodoxy and resulting limitations of the American Psychological Association's Clinical Practice Guideline for the Treatment of PTSD in Adults. Psychotherapy, 56(3), 329. [PubMed: 31282709]

Craske MG, Treanor M, Conway CC, Zbozinek T, & Vervliet B (2014). Maximizing exposure therapy: An inhibitory learning approach. Behaviour Research and Therapy, 58, 10–23. 10.1016/j.brat.2014.04.006 [PubMed: 24864005]

Cuijpers P, Sijbrandij M, Koole SL, Andersson G, Beekman AT, & Reynolds III CF. (2013). The efficacy of psychotherapy and pharmacotherapy in treating depressive and anxiety disorders: A meta-analysis of direct comparisons. World Psychiatry, 12(2), 137–148. [PubMed: 23737423]

Cukrowicz KC, Timmons KA, Sawyer K, Caron KM, Gummelt HD, & Joiner TE Jr (2011). Improved treatment outcome associated with the shift to empirically supported treatments in an outpatient clinic is maintained over a ten-year period. Professional Psychology: Research and Practice, 42(2), 145.

De Carvalho MR, Dias T. R. d. S., Duchesne M, Nardi AE, & Appolinario JC (2017). Virtual reality as a promising strategy in the assessment and treatment of bulimia nervosa and binge eating disorder: a systematic review. Behavioral Sciences, 7(3), 43. [PubMed: 28698483]

de Jong K, Conijn JM, Gallagher RA, Reshetnikova AS, Heij M, & Lutz MC (2021). Using progress feedback to improve outcomes and reduce drop-out, treatment duration, and deterioration: A multilevel meta-analysis. Clinical Psychology Review, 102002. [PubMed: 33721605]

Deacon BJ, & Farrell NR (2013). Therapist barriers to the dissemination of exposure therapy. In Handbook of treating variants and complications in anxiety disorders (pp. 363–373). Springer.

Deng W, Hu D, Xu S, Liu X, Zhao J, Chen Q, … Li X (2019). The efficacy of virtual reality exposure therapy for PTSD symptoms: A systematic review and meta-analysis. Journal of Affective Disorders, 257, 698–709. 10.1016/j.jad.2019.07.086 [PubMed: 31382122]

Department of Veterans Affairs, & Department of Defense. (2017). VA/DOD clinical practice guideline for the management of posttraumatic stress disorder and acute stress disorder Retrieved January 31 from https://www.healthquality.va.gov/guidelines/MH/ptsd/VADoDPTSDCPGFinal012418.pdf

Edmunds JM, Beidas RS, & Kendall PC (2013). Dissemination and implementation of evidence–based practices: Training and consultation as implementation strategies. Clinical Psychology: Science and Practice, 20(2), 152. [PubMed: 24072959]

Farrell NR, Kemp JJ, Blakey SM, Meyer JM, & Deacon BJ (2016). Targeting clinician concerns about exposure therapy: A pilot study comparing standard vs. enhanced training. Behaviour research therapy, 85, 53–59. [PubMed: 27567972]

Feijt MA, de Kort YAW, Bongers IMB, & Ijsselsteijn WA (2018). Perceived Drivers and Barriers to the Adoption of eMental Health by Psychologists: The Construction of the Levels of Adoption of eMental Health Model. J Med Internet Res, 20(4), e153. 10.2196/jmir.9485 [PubMed: 29691215]

Frank HE, Becker-Haimes EM, Rifkin LS, Norris LA, Ollendick TH, Olino TM, … Kendall PC (2020). Training with tarantulas: a randomized feasibility and acceptability study using experiential learning to enhance exposure therapy training. Journal of Anxiety Disorders, 76, 102308. [PubMed: 32992268]

Gallo KP, & Barlow DH (2012). Factors involved in clinician adoption and nonadoption of evidence-based interventions in mental health. Clinical Psychology: Science and Practice, 19(1), 93.

Gavgani AM, Hodgson DM, & Nalivaiko E (2017). Effects of visual flow direction on signs and symptoms of cybersickness. PloS one, 12(8), e0182790. [PubMed: 28777827]

Girard B, Turcotte V, Bouchard S, & Girard B (2009). Crushing virtual cigarettes reduces tobacco addiction and treatment discontinuation. CyberPsychology & Behavior, 12(5), 477–483. [PubMed: 19817561]

Glegg SM, Holsti L, Velikonja D, Ansley B, Brum C, & Sartor D (2013). Factors influencing therapists' adoption of virtual reality for brain injury rehabilitation. Cyberpsychology, Behavior, and Social Networking, 16(5), 385–401. [PubMed: 23713844]

Glisson C, Landsverk J, Schoenwald S, Kelleher K, Hoagwood KE, Mayberg S, … Research Network on Youth Mental Health. (2008). Assessing the organizational social context (OSC) of mental health services: Implications for research and practice. Administration and Policy in Mental Health and Mental Health Services Research, 35(1–2), 98. [PubMed: 18085434]

Glisson C, Schoenwald SK, Kelleher K, Landsverk J, Hoagwood KE, Mayberg S, … Research Network on Youth Mental Health. (2008). Therapist turnover and new program sustainability in mental health clinics as a function of organizational culture, climate, and service structure. Administration and Policy in Mental Health and Mental Health Services Research, 35(1–2), 124–133. [PubMed: 18080741]

Gold JI, Kim SH, Kant AJ, Joseph MH, & Rizzo AS (2006). Effectiveness of virtual reality for pediatric pain distraction during IV placement. CyberPsychology & Behavior, 9(2), 207–212. [PubMed: 16640481]

Gould RA, Buckminster S, Pollack MH, Otto MW, & Yap L (1997). Cognitive-behavioral and pharmacological treatment for social phobia: a meta-analysis. Clinical Psychology: Science and Practice, 4(4), 291.

Gros DF, Morland LA, Greene CJ, Acierno R, Strachan M, Egede LE, … Frueh BC (2013). Delivery of Evidence-Based Psychotherapy via Video Telehealth. Journal of Psychopathology and Behavioral Assessment, 35(4), 506–521. 10.1007/s10862-013-9363-4

Gunawan LT, van der Mast C, Neerincx MA, Emmelkamp P, & Krijn M (2004). Usability of therapist's user interface in virtual reality exposure therapy for fear of flying. 10th Annual Scientific Conference on Web Technology, New Media, Communications and Telematics Theory, Methods, Tools and Applications,

Gunter RW, & Whittal ML (2010). Dissemination of cognitive-behavioral treatments for anxiety disorders: Overcoming barriers and improving patient access. Clinical Psychology Review, 30(2), 194–202. 10.1016/j.cpr.2009.11.001 [PubMed: 19942331]

Harvard Business Review. (2014). The digital divide: First-mover advantage Retrieved January 19 from https://hbr.org/resources/pdfs/comm/verizon/18832_HBR_Verizon_Report_IT_rev3_webview.pdf

Helle J, Heldal I, Soleim H, Geitung A, & Larsen TF (2022). Virtual Reality Exposure Therapy for Claustrophobia: Evaluating usability and usefulness by clinicians. 2022 1st IEEE International Conference on Cognitive Aspects of Virtual Reality (CVR),

Horigome T, Kurokawa S, Sawada K, Kudo S, Shiga K, Mimura M, & Kishimoto T (2020). Virtual reality exposure therapy for social anxiety disorder: A systematic review and meta-analysis. Psychological medicine, 1–11.

Ionita G, & Fitzpatrick M (2014). Bringing science to clinical practice: A Canadian survey of psychological practice and usage of progress monitoring measures. Canadian Psychology/Psychologie canadienne, 55(3), 187.

Katzman MA, Bleau P, Blier P, Chokka P, Kjernisted K, & Van Ameringen M (2014). Canadian clinical practice guidelines for the management of anxiety, posttraumatic stress and obsessive-compulsive disorders. BMC psychiatry, 14(1), 1–83.

Kourtesis P, Collina S, Doumas LAA, & MacPherson SE (2019). Technological competence is a precondition for effective implementation of virtual reality head mounted displays in human neuroscience: a technological review and meta-analysis. Frontiers in Human Neuroscience, 13, 342. [PubMed: 31632256]

Lambert MJ, Whipple JL, & Kleinstäuber M (2018). Collecting and delivering progress feedback: A meta-analysis of routine outcome monitoring. Psychotherapy, 55(4), 520. [PubMed: 30335463]

Landauer TK (1997). Chapter 9 - Behavioral Research Methods in Human-Computer Interaction. In Helander MG, Landauer TK, & Prabhu PV (Eds.), Handbook of Human-Computer Interaction (Second Edition) (pp. 203–227). North-Holland. 10.1016/B978-044481862-1.50075-3

Leaman S, Rothbaum B, Difede J, Cukor J, Gerardi M, & Rizzo A (2013). Virtual reality Exposure therapy: A treatment manual for combat related PTSD. Handbook of military social work John Wiley & Sons, Inc., Hoboken, NJ, 113–140.

Lépine J-P (2002). The epidemiology of anxiety disorders: prevalence and societal costs. Journal of Clinical Psychiatry, 63, 4–8.

Lindner P, Miloff A, Zetterlund E, Reuterskiöld L, Andersson G, & Carlbring P (2019). Attitudes toward and familiarity with virtual reality therapy among practicing cognitive behavior therapists: a cross-sectional survey study in the era of consumer VR platforms. Frontiers in psychology, 10, 176. [PubMed: 30800086]

Marinelli-Casey P, Domier CP, & Rawson RA (2002). The gap between research and practice in substance abuse treatment. Psychiatric Services, 53(8), 984–987. [PubMed: 12161673]

McHugh RK, & Barlow DH (2010). The dissemination and implementation of evidence-based psychological treatments: a review of current efforts. American Psychologist, 65(2), 73. [PubMed: 20141263]

McMahon E, & Boeldt D (2021). Virtual Reality Therapy for Anxiety: A Guide for Therapists Routledge.

Michael T, Zetsche U, & Margraf J (2007). Epidemiology of anxiety disorders. Psychiatry, 6(4), 136–142.

Microsoft. (2023). *Health* Information Trust Alliance (HITRUST) Common Security Framework (CSF). Retrieved June 1 from https://learn.microsoft.com/en-us/compliance/regulatory/offering-hitrust

Miller WR, Sorensen JL, Selzer JA, & Brigham GS (2006). Disseminating evidence-based practices in substance abuse treatment: A review with suggestions. Journal of substance abuse treatment, 31(1), 25–39. [PubMed: 16814008]

Miller WR, Yahne CE, Moyers TB, Martinez J, & Pirritano M (2004). A randomized trial of methods to help clinicians learn motivational interviewing. Journal of consulting and clinical psychology, 72(6), 1050. [PubMed: 15612851]

Moore KA, Peters RH, Hills HA, LeVasseur JB, Rich AR, Hunt WM, … Valente TW (2004). Characteristics of opinion leaders in substance abuse treatment agencies. The American journal of drug and alcohol abuse, 30(1), 187–203. [PubMed: 15083561]

Morina N, Ijntema H, Meyerbröker K, & Emmelkamp PMG (2015). Can virtual reality exposure therapy gains be generalized to real-life? A meta-analysis of studies applying behavioral assessments. Behaviour Research and Therapy, 74, 18–24. 10.1016/j.brat.2015.08.010 [PubMed: 26355646]

Morina N, Kampmann I, Emmelkamp P, Barbui C, & Hoppen TH (2023). Meta-analysis of virtual reality exposure therapy for social anxiety disorder. Psychological medicine, 53(5), 2176–2178. [PubMed: 34001293]

Mozgai S, Leeds A, Kwok D, Fast E, Rizzo AS, & Hartholt A (2021). Building BRAVEMIND Vietnam: User-Centered Design for Virtual Reality Exposure Therapy. 2021 IEEE International Conference on Artificial Intelligence and Virtual Reality (AIVR),

Muir SD, de Boer K, Nedeljkovic M, & Meyer D (2020). Barriers and facilitators of videoconferencing psychotherapy implementation in veteran mental health care environments: a systematic review. BMC Health Services Research, 20(1), 999. 10.1186/s12913-020-05858-3 [PubMed: 33131495]

Opdyke D, Williford JS, & North M (1995). Effectiveness of computer-generated (virtual reality) graded exposure in the treatment of acrophobia. Am J psychiatry, 1(152), 626–628.

Pagoto SL, Spring B, Coups EJ, Mulvaney S, Coutu MF, & Ozakinci G (2007). Barriers and facilitators of evidence-based practice perceived by behavioral science health professionals. Journal of clinical psychology, 63(7), 695–705. [PubMed: 17551940]

Palma B (2021). Returning to providing psychotherapy in-person during a pandemic after providing online services: musing from an early career psychologist. Psychotherapy Bulletin, 56(3), 11–13.

Patterson DA, Dulmus CN, & Maguin E (2013). Is openness to using empirically supported treatments related to organizational culture and climate? Journal of social service research, 39(4), 562–571. [PubMed: 24159247]

Penn R, & Hout M (2018). Making reality virtual: How VR "tricks" your brain. Frontiers for Young Minds, 6(62). 10.3389/frym.2018.00062

Perle JG, Burt J, & Higgins WJ (2014). Psychologist and physician interest in telehealth training and referral for mental health services: An exploratory study. Journal of Technology in Human Services, 32(3), 158–185.

Pittig A, Kotter R, & Hoyer J (2019). The struggle of behavioral therapists with exposure: self-reported practicability, negative beliefs, and therapist distress about exposure-based interventions. Behavior Therapy, 50(2), 353–366. [PubMed: 30824251]

Rauch SA, Eftekhari A, & Ruzek JI (2012). Review of exposure therapy: a gold standard for PTSD treatment. Journal of rehabilitation research and development, 49(5), 679–688. [PubMed: 23015579]

Rimer E, Husby LV, & Solem S (2021). Virtual Reality Exposure Therapy for Fear of Heights: Clinicians' Attitudes Become More Positive After Trying VRET. Frontiers in psychology, 2952.

Riva G, Davide F, & IJsselsteijn W (2003). Being there: The experience of presence in mediated environments. Being there: Concepts, effects and measurement of user presence in synthetic environments, 5.

Rothbaum BO, Hodges L, & Smith S (1999). Virtual reality exposure therapy abbreviated treatment manual: Fear of flying application. Cognitive and Behavioral Practice, 6(3), 234–244.

Ruddle RA (2004). The effect of environment characteristics and user interaction on levels of virtual environment sickness. IEEE Virtual Reality 2004,

Salomon RM, Blackford JU, Rosenbloom ST, Seidel S, Clayton EW, Dilts DM, & Finder SG (2010). Openness of patients' reporting with use of electronic records: psychiatric clinicians' views. Journal of the American Medical Informatics Association, 17(1), 54–60. [PubMed: 20064802]

Saredakis D, Szpak A, Birckhead B, Keage HA, & Loetscher T (2019). Factors associated with virtual reality sickness in head-mounted displays: a systematic review and meta-analysis

Segawa T, Baudry T, Bourla A, Blanc J-V, Peretti C-S, Mouchabac S, & Ferreri F (2020). Virtual reality (VR) in assessment and treatment of addictive disorders: A systematic review. Frontiers in neuroscience, 1409. [PubMed: 31998066]

Shklarski L, Abrams A, & Bakst E (2021). Will We Ever Again Conduct in-Person Psychotherapy Sessions? Factors Associated with the Decision to Provide in-Person Therapy in the Age of COVID-19. Journal of Contemporary Psychotherapy, 51(3), 265–272. 10.1007/s10879-021-09492-w [PubMed: 33746247]

Silver KE, & Levant RF (2019). An appraisal of the American Psychological Association's Clinical Practice Guideline for the Treatment of Posttraumatic Stress Disorder. Psychotherapy, 56(3), 347. [PubMed: 31282711]

Slater M, & Wilbur S (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. Presence: Teleoperators & Virtual Environments, 6(6), 603–616.

Southam-Gerow MA, & Prinstein MJ (2014). Evidence base updates: The evolution of the evaluation of psychological treatments for children and adolescents. Journal of Clinical Child & Adolescent Psychology, 43(1), 1–6. [PubMed: 24294989]

Steinberg E, Greenfield S, Wolman DM, Mancher M, & Graham R (2011). Clinical practice guidelines we can trust National Academies Press.

Stewart RE, & Chambless DL (2007). Does psychotherapy research inform treatment decisions in private practice? Journal of clinical psychology, 63(3), 267–281. [PubMed: 17211876]

Uscher-Pines L, Raja P, Qureshi N, Huskamp HA, Busch AB, & Mehrotra A (2020). Use of tele–mental health in conjunction with in-person care: a qualitative exploration of implementation models. Psychiatric Services, 71(5), 419–426. [PubMed: 31996115]

Usmani SS, Sharath M, & Mehendale M (2022). Future of mental health in the metaverse. General Psychiatry, 35(4), e100825. [PubMed: 36189180]

Ventola CL (2008). Challenges in evaluating and standardizing medical devices in health care facilities. P & T : a peer-reviewed journal for formulary management, 33(6), 348–359. https://pubmed.ncbi.nlm.nih.gov/19561797 [PubMed: 19561797]

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2683611/

Von Ranson KM, Wallace LM, & Stevenson A (2013). Psychotherapies provided for eating disorders by community clinicians: Infrequent use of evidence-based treatment. Psychotherapy Research, 23(3), 333–343. [PubMed: 23088433]

Waller G, & Turner H (2016). Therapist drift redux: Why well-meaning clinicians fail to deliver evidence-based therapy, and how to get back on track. Behaviour research therapy, 77, 129–137. [PubMed: 26752326]

Weisz JR, Jensen-Doss A, & Hawley KM (2006). Evidence-based youth psychotherapies versus usual clinical care: a meta-analysis of direct comparisons. American Psychologist, 61(7), 671. [PubMed: 17032068]

Whiteside SPH, Deacon BJ, Benito K, & Stewart E (2016). Factors associated with practitioners' use of exposure therapy for childhood anxiety disorders. Journal of Anxiety Disorders, 40, 29–36. 10.1016/j.janxdis.2016.04.001 [PubMed: 27085463]

Woody SR, & Ollendick TH (2006). Technique factors in treating anxiety disorders. Principles of therapeutic change that work, 167–186.

Wray TB, & Emery NN (2022). Feasibility, Appropriateness, and Willingness to Use Virtual Reality as an Adjunct to Counseling among Addictions Counselors. Substance Use & Misuse, 57(9), 1470–1477. [PubMed: 35754378]

Yao R, Heath T, Davies A, Forsyth T, Mitchell N, & Hoberman P (2014). Oculus vr best practices guide. Oculus VR, 4

Yarber L, Brownson CA, Jacob RR, Baker EA, Jones E, Baumann C, … Brownson RC (2015). Evaluating a train-the-trainer approach for improving capacity for evidence-based decision making in public health. BMC Health Services Research, 15(1), 1–10. [PubMed: 25603697]

Zhu J, Park C, Gupta L, & Mukherjee D (2020). New payment models in medtech: Regulatory, technology, and marketplace trends converging to create new opportunities for manufacturers Deloitte. Retrieved January 2 from https://www2.deloitte.com/us/en/insights/industry/life-sciences/medical-device-business-model-payments.html

TABLE 1

Key data extracted from meta-analyses of studies comparing VR-assisted treatment to in vivo and waitlist controls for select anxiety disorders

Condition	***Study*** [1]	***Aggregate effect size, VR vs. waitlist/placebo***			***Aggregate effect size, VR vs. in vivo***		
		Number of RCTs included	***Total N***	***Effect size*** [2]	***Number of RCTs included***	***Total N***	***Effect size*** [2]
Specific phobias	Carl et al. (2019)	12	431	0.95*	5	206	−008
Posttraumatic stress disorder	Carl et al. (2019)	5	147	0.59*	--	--	--
	Deng et al. (2019)	6	175	0.57*	6	239	0.02
Social phobia	Carl et al. (2019)	7	236	0.97*	6	245	0.06
	Morina et al. (2023)	5	222	0.88*	7	272	0.07
Panic disorder	Carl et al. (2019)	2	65	1.03*	3	130	−0.26

[1] *Note.* Some of these included meta-analyses likely included some of the same studies.

[2] All effect sizes are reported in Hedge's *g*, and reflect effect sizes at follow-ups conducted immediately posttreatment.

* $p < .05$. Negative values reflect favor toward the control condition (waitlist/placebo or in vivo exposures).

TABLE 2

Case study of one therapist's path to adopting virtual reality exposure therapy and using it in her practice

Skylight Counseling Center is a private, group practice with offices in the greater Chicago area. The practice employs about 40 clinicians trained in a variety of disciplines, including social work, counseling, marriage and family therapy, and psychology. Given its proximity to local universities and colleges, the clinic serves a large number of young adults suffering with mood and anxiety disorders, but also serves patients at a variety of life stages and a number of conditions.

Natalie Jeung is a Licensed Clinical Professional Counselor who primarily works in the Center's Chicago, IL office. Natalie has a personal interest in video games and tends to serve patients with similar backgrounds and interests. She began looking into incorporating Virtual Reality (VR) into her practice after seeing that US Veteran's Affairs clinics were using VR to help treat PTSD, and she thought VR might be especially appealing for her adolescent patients. She felt VR's immersiveness would be a particularly useful strength for this population, given that they sometimes struggle to fully engage with techniques that necessitate using their imaginations.

When discussing the idea of incorporating VR into her practice with her colleagues, Natalie found that few others shared enthusiasm about it. Her sense was that few were familiar with its purpose and how they might integrate it into their practices and that they believed the learning curve could be too steep. However, she spoke with her employers about it, who were supportive of purchasing a system and license for her to use on a trial basis, with the caveat that they would evaluate returns on their investment sometime in the future.

Natalie initially searched the internet to learn more about the available options for VR-assisted therapy platforms and compare their offerings and costs. The number and types of VR experiences each platform offered was an important consideration for her, as was the hardware each platform used. In the end, though, the deciding factor was cost. She ultimately settled on a platform that was within their budget and that allowed users to purchase a perpetual license, avoiding recurring subscription costs and fees.

Natalie learned about how to use VR in her sessions primarily through publicly available trainings offered by VR researchers and tutorials created by other VR companies. The system she purchased does not integrate with patients' health records, and Natalie does not enter any identifiable patient data within the platform, so she experienced few security-related hurdles to implementing the system. Once Skylight purchased a system, set it up, and learned to use it, they added a page to their website announcing these services.

Natalie reports that patients have occasionally explicitly requested VR-assisted therapy, particularly for phobias and anxiety, even with this minimal advertising. However, most often, she decides which patients might benefit from using VR based on her judgement and whether a relevant experience is available that might help them with particular symptoms. She finds that adolescents and young adults are generally enthusiastic about trying it when she suggests it, and while adults sometimes seem a bit more reluctant, no patients have so far refused. Natalie noted that it generally takes about 10 minutes to orient patients to the system the first time they use it. A small percentage of her patients have reported some nausea when using VR.

Currently, Skylight bills for VR-assisted therapy the same way they would for normal individual therapy sessions, so recouping the costs of VR would mostly rely on attracting more patients by offering this service. However, Natalie notes that they approach it this way primarily because there is no widely-accepted approach to billing for VR-assisted services and they are not aware of other billing pathways. She believes she could make a much stronger business case for offering VR if they were able to bill at a slightly higher rate than typical therapy sessions.

Beyond cost, Natalie also reported other challenges to sustaining VR in her practice. One involves determining how to provide VR-assisted services to patients who want to receive care remotely. She noted that 25–50% of her patients have now returned to receiving services in-person, but many continue to prefer the convenience of remote counseling. If such a large percentage of patients continue to elect to receive care remotely in the future, it could pose significant barriers for both VR-assisted and in vivo exposure therapies. Another challenge arose when a competitor acquired the operations of the platform she purchased. Although Skylight purchased a perpetual license to the platform, the number of experiences available to therapists has since been much more limited as the company that acquired them focuses on other applications of VR. This has prevented her from using VR with as many patients as she might have otherwise. Although these challenges will hopefully become rarer as the field matures, this instability nevertheless makes it difficult to be confident about investing in a VR system.

TABLE 3

Summary of barriers to clinician adoption of virtual reality exposure therapy for anxiety disorders and potential solutions and research directions

Stakeholder	*Barrier*	*Potential solutions / research directions*
Product developers & researchers	• Inconclusive evidence of acceptance rates of VRET vs. in vivo exposures across anxiety conditions • Limited systematic knowledge about therapist adoption, ease of use, fit in typical workflows for therapists • Little understanding of evidence-based principles for guiding the use of VRET in treating various anxiety disorders in real world practice • Limited research about the effectiveness of VRET vs. other types of exposures in real-world clinical settings • Concerns about entering/storing PII/PHI in VR platforms • Delivering VRET when psychotherapy is conducted via telemedicine	• Larger studies of rates of refusal, session attendance, dropout among anxiety disorder patients offered VRET vs. in vivo exposures in clinical settings • Usability/user research with therapists to understand how they use VR platforms in everyday practice, and fit into their typical workflows • "Dosing" and administration studies to determine the optimal number, timing, and intensity of VRET exposures • Effectiveness trials, studies of real-world evidence, or hybrid implementation-effectiveness trials to test VRET's benefits in more realistic settings • Developers should consider pursuing appropriate security certifications or enabling therapists to use the platform without collecting/storing PII/PHI • Identifying clear models of VRET delivery via telemedicine, research exploring barriers and strategies to facilitate VRET use in telemedicine
Therapists & training	• Therapists are unfamiliar with VR-based exposure treatments, platforms that can be used to deliver them, and/or are unconvinced of their realism/ potency • Lack of training, both on the job and in graduate training programs • Negative attitudes about exposure-based techniques, empirically-supported treatments • Few "champions" of VRET in many workplaces/organizations • Concerns about lack of trust in patients	• Conduct more live demonstrations of VRET in large behavioral healthcare settings to give therapists first-person experiences with exposures • Workplace-based trainings that provide training and directly confront negative attitudes/beliefs • Identify influential mentors and opinion leaders, incentivize them to discuss it with colleagues/ mentees • Build partnerships with clinical training programs to train students, incorporate VR into their teaching clinics • Facilitate research exploring best practices for establishing rapport and trust prior to initiating VRET
Clinics	• Low demand from patients for VR-assisted treatment • Clinics may see risk in being "fast movers" in adopting VR • Concerns about legal obligations, contract terms with VR platforms regarding patient health information	• Design advertising campaigns highlighting the use of VR-assisted treatment as a more comfortable and innovative alternative to relying on traditional exposures alone • Collect and report data on benefits and value for clinics that have adopted VR • Work with developers to adapt their software, terms, & policies to fit clinics' obligations/needs
Professional Organizations	• Little recognition of VRET as an efficacious treatment in anxiety disorder clinical practice guidelines	• Address VR's potential in psychotherapeutic treatments for anxiety disorder more directly when updating guidelines
Cost & Revenue	• Few pathways for providers to recoup the costs associated with purchasing VR hardware, licensing software, and providing ongoing training, maintenance, and support of the system	• Therapist trainings to help them improve their billing practices • Consult with payers about pathways for increasing reimbursement rates for VR-assisted psychotherapy sessions • Explore value-based contracting approaches

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Stakeholder	*Barrier*	*Potential solutions / research directions*
		• Identify ways to help providers attract more patients using VR

Note. VRET: Virtual Realty Exposure Therapy. PHI: Protected health information. PII: Personally identifiable information.