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Exploring the Therapeutic Potential of Virtual Reality in Medical Practice: A Systematic Review

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ABSTRACT

Virtual reality (VR) is rapidly emerging as a disruptive technology in healthcare, providing new opportunities for therapeutic intervention, patient engagement, and clinical support. This systematic literature review investigates the therapeutic potential of virtual reality in medical practice by synthesizing current research on applications, outcomes, and implementation challenges. The review was guided by a single research question: what is the therapeutic potential of virtual reality in medical practice? The PRISMA-based systematic literature review method was used to ensure a transparent and structured selection procedure. Data were acquired from two main academic databases: Scopus and ERIC. The initial search yielded 3,031 records from Scopus and 141 from ERIC. After deleting duplicates and screening titles, abstracts, and full-text articles based on predetermined inclusion and exclusion criteria, only 35 papers were kept for further research. The results were divided into three primary themes: therapeutic outcomes, clinical applications, and implementation challenges. The first topic emphasizes VR's benefits in relieving pain, anxiety, and tension, as well as promoting physical and psychological rehabilitation. The second theme focuses on the practical application of virtual reality in a variety of medical situations, such as patient care, therapeutic procedures, rehabilitation settings, and clinical interventions. The third subject covers potential impediments to widespread use, such as cost, technological restrictions, training needs, and integration into existing medical systems. Overall, the analysis suggests that VR has significant therapeutic potential in medical practice, notably for improving patient experience and complementing non-pharmacological therapies. However, its long-term effectiveness and scalability are still contingent on improved clinical validation and more sustainable deployment tactics. This study adds to the growing body of literature by providing a focused synthesis of how VR is being positioned not only as a technological novelty, but also as a valuable therapeutic tool in modern medical practice.

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1. Introduction

Virtual reality (VR) has emerged as one of the most promising technical advancements in modern healthcare, notably for its ability to help therapeutic processes in a variety of medical contexts. VR was once primarily linked with amusement and digital gaming, but it has now evolved into a sophisticated technology capable of creating immersive, interactive, and controllable settings that may be tailored for clinical applications[1]. In medical practice, technological advancements have created new avenues for therapy, rehabilitation, symptom control, and patient involvement[2]. As healthcare systems continue to incorporate digital solutions into clinical processes, VR is being recognized not only as a novel technology, but also as a potentially meaningful therapeutic tool that can supplement traditional medical techniques[3].

The increased interest in VR in healthcare stems from its ability to recreate realistic or carefully tailored surroundings that influence both physical and psychological reactions. Unlike traditional treatment modalities, which frequently rely on verbal instruction, static media, or passive involvement, virtual reality provides patients with an immersive experience that actively engages their attention, perception, and body interaction[4]. This ability to immerse is especially crucial in therapeutic settings, as patient motivation, emotional state, and behavioral reaction frequently influence treatment outcomes. VR may provide highly responsive therapeutic settings that enable intervention in ways that standard clinical techniques are unable to accomplish[5]. As a result, researchers and practitioners are increasingly investigating its application in pain relief, anxiety reduction, psychological treatment, neurorehabilitation, motor recovery, and other areas of patient care[6].

One of the primary reasons VR has gained popularity in medical practice is its ability to address both the physiological and psychological aspects of treatment[4]. In recent years, healthcare has shifted to more patient-centered approaches that recognize the value of comfort, experience, engagement, and emotional well-being in the healing process[7]. VR greatly supports this trend since it enables treatment to be provided in an engaging, adaptive, and typically less threatening manner for patients[8]. Immersive virtual environments, for example, may assist patients redirect their attention away from painful operations, reduce anticipatory worry, and encourage them to participate more fully in rehabilitation exercises. Such applications imply that VR has the potential to improve not only clinical effectiveness but also the humanisation of care, which is becoming an increasingly relevant concern in current medical practice[9], [10].

Simultaneously, the therapeutic use of VR represents a larger shift in healthcare, in which technological systems are being used to improve service quality, personalize intervention, and increase access to innovative treatment models[11]. Medical institutions are now investigating how digital tools might improve productivity and patient outcomes while retaining the central role of healthcare personnel. Within this framework, VR is particularly important because it is not limited to a single function or specialty. Rather, it provides a wide range of medical services, including mental health intervention, physical rehabilitation, procedural support, and chronic pain management[12], [13]. This variety of applicability implies that virtual reality should not be considered as a niche or experimental technology in isolation, but rather as part of an emerging therapeutic ecosystem that is transforming how treatment is conceptualized and delivered.

Despite its growing popularity, VR in medical practice remains theoretically and operationally complicated. The literature on VR in healthcare is extensive and frequently fragmented, encompassing a variety of disciplines, patient demographics, technology configurations, and therapeutic objectives[14]. Some studies emphasize measurable health improvements, whilst others concentrate on user experience, feasibility, or implementation techniques. This diversity of evidence

makes it challenging to develop a comprehensive picture of VR's therapeutic potential[15], [16]. In certain circumstances, encouraging results are reported in highly controlled settings, but their application to ordinary clinical practice is dubious. In other circumstances, VR is treated as a technological possibility rather than a clinically established intervention[17]. As a result, available research must be thoroughly synthesized in order to identify the main patterns, strengths, and limitations of virtual reality as a therapeutic tool in medical practice[18].

This need is accentuated by the increasing growth of publications in this field. As digital health research expands, studies on VR become more interdisciplinary, encompassing medicine, psychology, rehabilitation science, human-computer interface, and health technology[19]. While multidisciplinary richness is valuable, it can lead to conceptual overlap and terminology inconsistencies. The terms immersive therapy, digital intervention, virtual rehabilitation, and simulation-based treatment are occasionally used interchangeably, despite the fact that they may relate to distinct aims or levels of technological sophistication. A systematic literature review is especially significant in this context because it allows researchers to map the area in a structured manner, uncover common themes, and clarify how therapeutic VR is currently understood and utilized in medical contexts[17], [18].

When reviewing the literature, three interconnected elements emerge as particularly crucial for understanding VR's therapeutic potential in medical practice. The first is about Therapeutic Outcomes, which refer to the clinical and sensory outcomes created by VR-based therapy. These may include pain relief, improved emotional management, reduced anxiety, increased motivation, and improved rehabilitation performance[12], [14]. Such outcomes are important because they directly reflect whether VR adds value to patient well-being and therapeutic success. The second feature is Clinical Applications, which refers to the numerous settings in which VR is employed, such as rehabilitation programs, mental health therapy, procedural assistance, palliative care, and patient-centered treatments in hospitals or specialized clinics[11], [20]. Understanding these uses helps to place VR in the context of actual medical practice, rather than seeing it as an abstract technology abstraction. The third category is Implementation Challenges, which include practical, organizational, and technological hurdles to adoption[21]. These include the expense, equipment restrictions, staff training, patient fit, digital literacy, ethical problems, and integration into existing healthcare systems. Together, these three elements form a valuable analytical framework for comprehending both the potential and the complexities of VR in medical practice[9].

Against this context, the current study seeks to investigate the therapeutic potential of virtual reality in medical practice by a systematic literature review. The review is guided by the research question, "What is the therapeutic potential of virtual reality in medical practice?" By addressing this topic, the study hopes to synthesize current evidence on how VR is utilized therapeutically, what types of outcomes have been documented, and what challenges continue to impact its use in healthcare settings. Rather than focusing on instructional or training uses of VR, this review focuses on therapeutic and patient-related applications in medical settings. This distinction is significant because it enables a more concentrated assessment of VR as a tool for therapy and intervention, rather than instruction and simulation for learning.

The value of this review stems from its ability to contribute both philosophically and practically. From a scholarly standpoint, it provides a focused summary of a fast emerging area that is frequently addressed across disparate disciplinary boundaries. From a practical standpoint, it may help physicians, healthcare administrators, and legislators better understand where VR can provide value to patient care and what circumstances are required for long-term implementation. As medicine evolves with digital innovation, the therapeutic use of VR requires careful and critical consideration. This study intends to provide a greater understanding of whether VR should be seen as a developing

accessory in healthcare or as a truly transformational therapeutic medium with long-term value for medical practice.

2. Literature Review

The rising corpus of research on virtual reality (VR) in healthcare represents a significant shift in how technology is conceptualized within modern medical practice. Rather than being seen only as an improved visual medium or simulation system, virtual reality is increasingly recognized as a therapeutic resource capable of influencing clinical outcomes, patient experience, and treatment participation[10]. This transition is shaped in part by developments in immersive technology, but it is also influenced by broader healthcare reforms, such as patient-centered care, digital innovation, and non-pharmacological therapeutic tactics[22]. Within this developing landscape, virtual reality (VR) has received scholarly attention for its ability to deliver immersive, controlled, and interactive environments that can support therapeutic processes across a wide range of medical illnesses and treatment settings[23].

A prominent strand of the literature emphasizes VR's therapeutic capacity to improve patient outcomes in both physical and psychological dimensions. Much of the early excitement about VR in medicine stemmed from its capacity to divert patients from pain and anguish during medical procedures[8]. The use of VR for attention modulation remains one of the most commonly explored therapeutic uses in the literature. VR can lessen patients' perception of pain, anxiety, and discomfort by immersing them in visually appealing and intellectually stimulating surroundings, especially during acute operations or stressful clinical situations[24]. This technique is frequently framed within theories of cognitive distraction and sensory redirection, in which the patient's attention is diverted away from the medical setting and into a more regulated and less dangerous virtual space. As a result, VR has been positioned as a beneficial addition to standard pain management and anxiety reduction tactics, particularly in situations when pharmacological intervention alone may be insufficient or undesired[4].

Beyond short-term symptom relief, the literature emphasizes the importance of virtual reality in rehabilitation and recovery processes. Immersive virtual worlds can be utilized in physical therapy to encourage patients to perform repetitive movement-based activities that might otherwise be considered tedious or depressing[25]. This is especially important in neurorehabilitation and musculoskeletal therapy, where consistent repetition, feedback, and patient participation are essential for recovery. VR's interactive nature enables for the gamification or personalization of therapeutic tasks, enhancing patient motivation and compliance[3], [5]. Several publications consider VR-based rehabilitation as effective not just because it improves motor training, but also because it makes therapy more interesting and psychologically satisfying[26]. This shows that therapeutic effectiveness in VR is not limited to the direct clinical effect of an activity or intervention, but also includes how the therapeutic environment influences motivation, confidence, and long-term engagement[6].

Another significant area where VR has shown therapeutic promise is psychological and emotional well-being[2]. The research demonstrates an increasing interest in virtual reality-assisted interventions for mental health issues such as anxiety disorders, phobias, stress management, and emotion control[27], [28]. In these settings, VR is frequently utilized to construct safe yet immersive therapeutic environments in which patients can gradually meet, process, or manage disturbing stimuli under controlled conditions. The attractiveness of VR in mental health stems from its capacity to combine exposure, control, and immersion in ways that can be adjusted to specific therapeutic requirements[1]. In certain circumstances, VR enables therapists to imitate environments that would

be impossible, expensive, or ethically complex to recreate in the actual world. In other circumstances, it provides a more accessible or less scary way into therapeutic involvement, particularly for patients who are hesitant to participate in traditional therapeutic procedures[29]. This collection of work supports the notion that VR can serve as a versatile therapy platform capable of addressing not only physical healing but also emotional and psychological requirements[30].

In terms of therapeutic scope, the literature shows that VR has progressed beyond experimental applications and is now being used in a variety of medical contexts. It has been considered in several contexts, including pain clinics, rehabilitation centers, oncology departments, mental health services, surgical preparation, and chronic care management[31]. This breadth of applicability supports the notion that VR is not limited to a single specialization, but rather serves as a cross-cutting therapeutic tool[32]. It is frequently used in therapeutic rehabilitation for movement training, balance enhancement, cognitive stimulation, and functional recovery. It is used in procedural care to alleviate patient discomfort during wound care, injections, and other unpleasant procedures[18]. It is used in mental health and behavioral medicine as a means of therapeutic exposure, relaxation, emotional processing, or coping support[33]. Some studies also look into its use in palliative or long-term care settings, where patient comfort, mood, and quality of life are primary therapeutic concerns. These diverse clinical uses show that VR's worth is largely due to its versatility, which allows it to be customized based on medical aims, patient situations, and care contexts[34].

Fig. 1. Virtual reality force feedback spine surgery simulator training for pedicle screw placement [10]

However, despite promising findings, the literature does not portray VR as a universally accepted or problem-free option. A common issue in numerous research is the practical and structural challenges of implementation. Cost is a commonly mentioned issue, especially in terms of hardware, software development, system maintenance, and long-term institutional investment[35]. Although VR systems have become more affordable over time, their use in therapeutic settings still necessitates financial investment, technical assistance, and administrative preparation. Many healthcare settings, particularly those with limited resources, are concerned not just with the effectiveness of VR, but also with its feasibility and sustainability in normal practice[17].

Another problem is usability and technological suitability. Not all patients react to VR in the same manner, and some may feel discomfort, disorientation, or motion-related side effects. This raises critical concerns concerning patient selection, therapeutic appropriateness, and the design of VR therapies itself. Furthermore, the research emphasizes the importance of providing healthcare personnel with proper training in the usage of VR systems[16]. Even theoretically successful therapies may fail to deliver meaningful outcomes if the technology is not properly understood and integrated into therapeutic workflows[15]. The effectiveness of virtual reality in medical practice is thus dependent not only on the technology's quality, but also on practitioners' and institutions' readiness to use it effectively[14].

The literature also indicates that evidence for VR's long-term therapeutic effectiveness is inconsistent. While several studies claim excellent short-term results, doubts remain about durability, standardization, and generalizability[14]. Outcome measures differ significantly between trials, making comparison difficult. Some studies focus on subjective sensations like enjoyment or comfort, whilst others look at pain scores, functional recovery, or psychological indications[12]. This variance reflects the field's interdisciplinary nature, but it also emphasizes the need for increased methodological uniformity[13]. Furthermore, sample sizes are frequently small, and intervention designs might vary significantly between research, making it difficult to draw broad conclusions regarding therapeutic effectiveness. As a result, the literature broadly supports VR as a promising therapeutic tool, but not as a fully standardised or universally validated component of medical practice[20].

Taken together, the research portrays VR as an emerging therapeutic medium with significant potential but persistent complexities. Its most notable strengths are its ability to deliver significant treatment effects, operate in a wide range of clinical applications, and improve patient involvement through immersion and interactivity[11]. At the same time, its adoption is influenced by implementation problems that go beyond technology, including infrastructure, training, design, cost, and evidence quality. These tensions make VR a particularly essential topic for rigorous research[21]. A focused review is therefore required not merely to determine where VR looks to be most therapeutically useful, but also to understand the conditions under which its usage can be clinically meaningful, ethically suitable, and operationally viable[9]. In this view, the literature indicates not just the promise of VR in medical practice, but also the importance of critical synthesis in distinguishing between innovation and proof, and possibility and practicality[10].

3. Methodology

3.1 Identification

In choosing several appropriate papers for this report, the systematic review process consists of three main phases. The first step is keyword recognition and the quest for linked, similar terms based on the thesaurus, dictionaries, encyclopedia, and previous studies. Accordingly, after all the relevant keywords were decided, search strings on Scopus and ERIC (see Table 1) database have been created. In the first step of the systematic review process, the present research work successfully retrieved 3172 papers from both databases.

The identification phase involves searching for study materials relevant to the predetermined research issue. The keywords used are Virtual reality, medical practice, therapeutic applications and clinical intervention. Therefore, the first step was to detect keywords and search for similar, equivalent phrases in previous research. As a result, after determining all relevant phrases, search strings for the Scopus and ERIC databases were created (see Table 1). Thus, during the first part of the advanced searching procedure, this study effectively obtained 70 publications from the databases.

Table 1
Search String

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2023 – 2026	< 2023
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press

2.2 Screening

Duplicated papers should be excluded during the first step of screening. The first phase omitted 1556 articles, while the second phase screened 1496 articles based on several inclusion-and-exclusion criteria developed by researchers. Literature (research articles) was the first criterion because it is the primary source of practical information. It also includes the exclusion from the current study of publications in the form of systematic review, review, meta-analysis, meta-synthesis, book series, books, chapters, and conference proceedings. Furthermore, the review concentrated exclusively on papers written in English. It is essential to note that the schedule was chosen for a Three-year duration (2023–2026). In all, 1461 publications based on specific parameters were excluded.

Table 2
The selection criterion is searching

Criterion	**Inclusion**	**Exclusion**
Language	English	Non-English
Time line	2023 – 2026	< 2023
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press

For the third step, known as eligibility, a total of 1496 articles have been prepared. All articles titles and key content were thoroughly reviewed at this stage to ensure that the inclusion requirements were fulfilled and fit into the present study with the current research aims. Therefore, 1461 reports were omitted because they were Full text excluded, due to the out of field (n=487), Title not significantly (n=400), Abstract not related on the objective of the study (n=574) based on empirical evidence. Finally, 35 articles are available for review (see Table 3).

2.3 Data Abstraction and Analysis

One of the assessment procedures employed in this study was integrative analysis, which was used to investigate and synthesize a variety of research designs (quantitative, qualitative, and mixed methods). The competence study's purpose was to discover significant themes and subtopics. The stage of data collection was the first step in the theme's development.

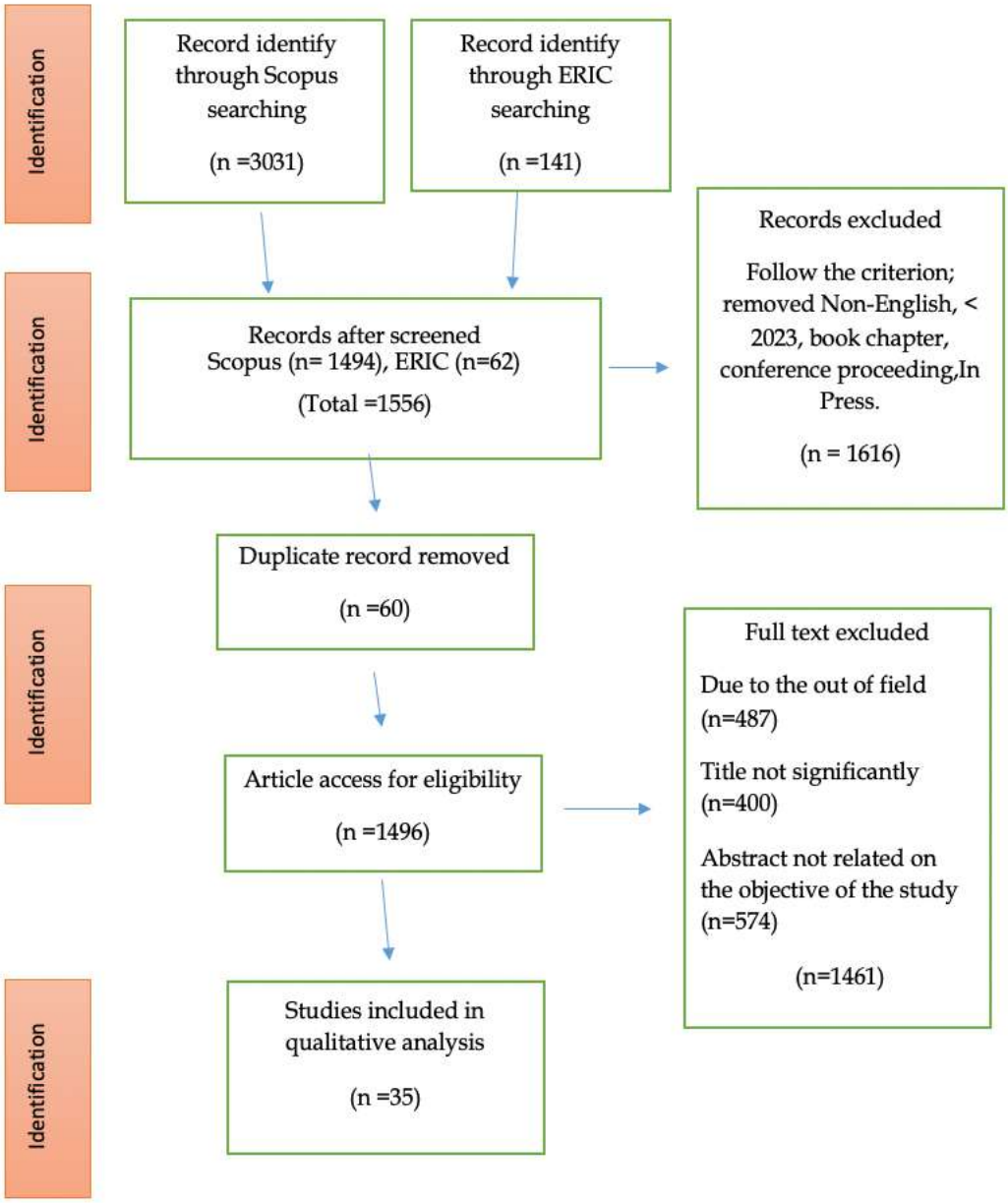

Fig. 2. Flow diagram of the proposed searching study [5]

Figure 2 depicts how the author methodically examined a collection of 70 articles for assertions or material relevant to the current study's issues. The authors next reviewed the most recent significant papers on Virtual reality and medical practice. The methods employed in all investigations, as well as the research findings, are being looked into. Following that, the author worked with other co-authors to build themes based on the data in Virtual reality, medical practice, therapeutic applications and clinical intervention.(Mohd Ekram Hashim-expert in new media (Virtual reality) Nur

Safinas expert in media stratergies, Hamidah Idris expert in science and medical practise) to determine the validity problems. The expert review phase ensures the clarity, importance and suitability of each subtheme by establishing the domain.

4. Synthesis analysis

4.1 Therapeutic Outcomes

Virtual reality (VR) has advanced from a novel technology interface to a clinically relevant therapeutic medium capable of producing measurable physiological, psychological, and behavioral results in medical practice. Therapeutic outcomes in the evaluated research are not limited to rapid symptom relief, but also include larger aspects including emotional regulation, empathy development, clinical confidence, and patient participation. This demonstrates that VR contributes to both direct and indirect therapeutic processes, establishing it as a multifaceted intervention in modern healthcare systems.

A increasing amount of studies demonstrates VR's effectiveness in improving emotional and cognitive preparedness, particularly in high-pressure clinical settings. For example, immersive VR therapies have been demonstrated to dramatically enhance mental health literacy, self-perceived competence, confidence, and empathy in the management of psychiatric agitation [32]. Although such findings are frequently drawn from training settings, their implications are immediately applicable to therapeutic practice, where effective agitation control is largely dependent on emotional readiness, communication quality, and situational response [18]. Notably, the reduction in stigma toward people with mental illnesses demonstrates VR's ability to affect attitudes that shape therapeutic relationships. This shows that VR promotes not only cognitive benefits, but also relational and affective outcomes that are critical for patient-centered care.

Similarly, simulations that allow for perspective-taking have been shown to improve comprehension of patient experiences. Evidence from VR-based autism simulations suggests that participants develop more favorable attitudes, knowledge, and openness toward people with autism [22]. While primarily designed as awareness interventions, such outcomes have substantial therapeutic implications. In medical practice, therapeutic effectiveness is determined not only by clinical recovery but also by practitioners' capacity to perceive and respond to patient experiences with sensitivity and insight [36]. VR helps to create more empathic and humanized care environments, which are essential for boosting trust, communication, and overall treatment quality.

In addition to these relationship effects, VR has great promise in direct therapeutic applications, particularly pain treatment. VR's analgesic benefits are supported by empirical research, including subjective reports and objective physiological measurements. Studies using EEG-based indications show that immersive distraction can dramatically lower pain-related responses, bolstering the case that VR's effects go beyond novelty or placebo mechanisms [36]. This establishes VR as a viable non-pharmacological intervention, consistent with broader healthcare trends toward multimodal and less invasive therapy techniques [24]. Such findings answer long-standing concerns about VR's therapeutic credibility by giving quantifiable evidence of its clinical impact.

Similar trends have been reported in oncology settings, where VR has been used to reduce pain, anxiety, and emotional distress associated with cancer therapy [33]. These findings are especially relevant given that the burden of sickness in oncology includes not only physical symptoms but also psychological and emotional strain. VR, in this context, serves as part of a supportive care framework, addressing patients' whole needs rather than providing merely momentary respite [34]. However, the literature emphasizes the importance of suitable institutional frameworks, such as training, funding, and payment procedures, to ensure treatment effectiveness. This emphasizes the

significance of connecting clinical outcomes with implementation preparedness to achieve long-term impact.

Beyond discomfort relief, VR improves diagnostic and procedural precision, increasing therapy quality indirectly. Evidence suggests that immersive visualisation improves doctors' capacity to evaluate complex anatomical circumstances and surgical planning, especially in paediatric patients including congenital malformations [18]. While these outcomes may not have direct therapeutic impacts, they are important predictors of treatment success because proper diagnosis and planning have a direct impact on patient safety and intervention outcomes. In this respect, VR contributes to the overall therapeutic chain by improving the conditions under which care is administered

This indirect impact is supported by studies that show advances in radiological analysis and image annotation in immersive environments. VR-based systems have been proven to improve annotation accuracy and clinical usability, especially when used in conjunction with AI-generated outputs [30]. By allowing for more exact manipulation and interpretation of medical data, VR promotes informed decision-making and increases the possibility of successful intervention [31]. These findings indicate that VR's therapeutic efficacy goes beyond patient-facing applications, including advances in clinical reasoning and diagnostic reliability.

Furthermore, research undertaken in training and educational settings produces results with evident therapeutic applications. VR-based communication training has been linked to enhanced confidence in dealing with emotionally demanding situations, and other studies have found gains in infection control knowledge and decision-making readiness [3,28]. Although these outcomes are not direct indicators of patient recovery, they are important prerequisites for good therapeutic treatment. Treatment outcomes in healthcare are influenced not just by therapies, but also by the quality of communication, judgment, and professionalism. Thus, these findings might be viewed as pre-therapeutic characteristics that improve overall care delivery.

Nonetheless, a more cautious approach is required when evaluating these results. Several studies show increases in engagement, information retention, and skill acquisition; nonetheless, their major aim is educational rather than therapeutic [14]. This demonstrates an important conceptual distinction in the literature. Not all favorable outcomes from VR should be construed as proof of therapeutic efficacy. A clear distinction between educational benefits and clinical impact is required to allow an appropriate assessment of VR's function in medical practice. The therapeutic outcomes theme's strength is not only in recognizing favorable results, but also in understanding which outcomes have a direct impact on patient well-being, clinical quality, and therapeutic interaction.

Overall, the evaluated research indicate that VR improves treatment results via several paths. It can alleviate pain and mental discomfort, increase empathy and openness, aid in more accurate diagnosis and planning, and boost communication and confidence in care-related decisions. VR's multifaceted nature looks to have a particularly strong therapeutic potential. It serves as more than just a distraction tool or visual help; it is also an immersive platform that can influence how medicine is delivered, interpreted, and emotionally experienced. At the same time, the literature suggests that therapy effects require nuanced interpretation. Some are direct and measurable, such as pain relief, while others are indirect but equally important, such as increased understanding, empathy, and clinical precision. Taken together, this theme lends strong support to the claim that VR has tremendous therapeutic promise in medical practice, not because it replaces traditional treatment, but because it enriches the therapeutic process in clinically useful and humane ways.

4.2 Clinical Applications

The theme of Clinical Applications demonstrates how virtual reality is being positioned in the literature as a highly adaptable tool with applications in all stages of medical practice, from procedural preparation and surgical navigation to communication, emergency response, and patient-facing therapeutic support. What makes this issue particularly important is that VR is not limited to a single clinical use. Instead, it appears to function as a versatile application platform that may be customized to meet various procedural, diagnostic, communicative, and rehabilitative needs. This range of use implies that the expanding value of VR in medicine stems not only from immersion, but also from its ability to translate complex clinical activities into interactive and regulated experiences that are safer, reproducible, and frequently more accessible than traditional techniques.

A large body of data links VR to procedural and surgical applications, where technology aids skill acquisition through repetitive, risk-free simulation. According to studies, VR-based environments improve technical abilities such as wound debridement, suturing, and laparoscopic navigation by allowing users to practice in realistic and structured scenarios [16,19]. Importantly, these simulations go beyond visual representation to aid in the internalisation of procedural logic and clinical reasoning. In this way, VR evolves from a passive simulation medium to an active performance assessment tool capable of facilitating competency benchmarking and mastery-based learning before real-world clinical exposure. Further research suggests that force-feedback VR systems improve surgical precision, including pedicle screw placement, at all levels of experience, emphasizing their importance not just for beginner training but also for ongoing professional development [10].

The use of advanced features like as three-dimensional modeling, haptic feedback, and adaptive learning methods enhances VR's function in procedural optimisation. Platforms that incorporate these characteristics have been proven to improve accuracy, save training time, and minimize procedural errors while also increasing user confidence [13]. Such advancements reflect a broader trend toward precision-oriented training models, in which VR is embedded into intelligent systems capable of providing personalized feedback and performance-driven adaptation. As a result, VR is becoming more aligned with data-driven and clinically responsive training paradigms that value efficiency, accuracy, and user-specific advancement.

Beyond procedural domains, VR has a major impact on clinical communication and decision-making, highlighting the importance of relationship competency in healthcare delivery. Immersive simulation systems provide a secure and regulated setting for practicing complex interpersonal interactions, such as emotionally charged conversations and key decision-making scenarios [20]. Evidence suggests that such applications boost practitioner confidence and communication efficacy without putting real patients at danger. Complementary data demonstrate that VR-based communication training is commonly regarded as practicable, engaging, and appropriate in a variety of institutional settings [11]. These findings are particularly relevant since communication quality has a direct impact on patient trust, informed consent, emotional well-being, and overall treatment success. As a result, VR's therapeutic relevance extends beyond technical training to include the interpersonal aspects of care.

The use of VR in emergency and interprofessional training indicates its ability to imitate high-risk, time-sensitive clinical scenarios. Virtual platforms allow healthcare personnel to participate in coordinated response scenarios that simulate ward-level urgency and complicated cooperation dynamics [26]. This is especially useful in instances where real-world experience is limited or unexpected. VR promotes the development of individual competences as well as collaborative performance, both of which are essential for effective emergency care delivery. In this setting, VR

not only improves readiness but also boosts interprofessional coordination, which is an important factor of therapeutic quality.

The literature also indicates that VR is increasingly being used in patient preparation and anxiety-related clinical contexts, however the results are varied. Saliba, Aleman-Gomez, and Rotzinger's meta-analysis of VR mock MRI experiences found that, despite some hopeful patterns, this application did not significantly lower pre-exam anxiety. This study is useful because it challenges the notion that VR will always deliver favorable results. While the concept of employing virtual reality to familiarize patients with daunting procedures is clinically appealing, data reveals that application efficacy is significantly influenced by intervention design, patient characteristics, and methodological consistency. In other words, the expansion of therapeutic applications should not be confused with universal efficacy. Some applications remain promising but immature, and this serves as a timely reminder that the significance of virtual reality in medicine must be assessed contextually rather than hailed in overly broad terms.

In patient-oriented applications, VR has been investigated for procedure familiarization and anxiety reduction, although the evidence is inconsistent. While immersive simulations have the potential to reduce uncertainty and increase patient preparedness, meta-analytic studies show that such interventions do not consistently result in significant reductions in pre-procedural anxiety, particularly in scenarios like mock MRI exposure [17]. These variations underscore the impact of intervention design, patient variables, and methodological heterogeneity on therapeutic results. As a result, the proliferation of VR applications should not be mistaken for universal effectiveness, as some use cases remain exploratory and context-dependent.

At a broader level, the research shows that VR is becoming more integrated into the expanding digital healthcare ecosystem, frequently in conjunction with extended reality (XR) technology and complex computational systems [5,8]. These discoveries point to a trend toward more adaptable, multimodal, and intelligent healthcare environments, with immersive technology contributing to real-time feedback, procedural improvement, and increased workflow efficiency. However, any integration must also be compatible with existing clinical systems, infrastructure, and operational requirements in order to be implemented effectively.

Despite its growing reach, the use of VR in therapeutic settings is accompanied with operational and safety concerns. Evidence suggests that VR head-mounted displays can act as reservoirs for dangerous germs even after cleaning, raising concerns about infection management in high-risk areas including operating rooms and intensive care units [23]. This finding emphasizes the importance of rethinking VR devices as therapeutic tools that must adhere to the same hygiene and safety standards as conventional medical equipment. As a result, thorough cleaning processes and equipment design considerations must be in place to enable safe clinical usage with VR.

Furthermore, the literature emphasizes the significance of conceptual clarity and standardisation in VR-related research. Inconsistencies in nomenclature across VR, AR, XR, and immersive simulation frameworks impede comparability and the formulation of cohesive therapeutic standards [27]. This lack of definitional uniformity has practical ramifications for implementation, procurement, and evaluation processes, as well as scholarly discourse. Creating a single taxonomy is thus critical for increasing cumulative knowledge and promoting evidence-based integration into therapeutic practice.

Overall, the subject of clinical applications demonstrates that VR is being used for a wide range of medical activities, including procedural rehearsal, surgical assessment, communication training, emergency readiness, patient familiarisation, and overall workflow innovation. However, the literature demonstrates that this diversity is both a strength and a challenge. It highlights VR's adaptability while also raising concerns about consistency, evidence, and contextual fit. Some uses,

particularly in procedural and surgical settings, look established and well-supported. Others, such as anxiety reduction before MRI or large-scale headset use in hospital settings, are more experimental and operationally demanding. Taken together, these findings demonstrate that the true value of VR in clinical applications rests not in its novelty, but in its ability to fill a variety of functional functions within medical practice. VR is rapidly being positioned as a versatile therapeutic medium whose value is determined by how well it is connected with current healthcare needs, professional processes, and safety criteria.

4.3 Implementation Challenges

The issue of Implementation Challenges illustrates that the promise of virtual reality in medical practice is frequently accompanied by practical, methodological, and institutional hurdles that limit how far its therapeutic usefulness may be realized. VR is commonly regarded as novel, interesting, and possibly transformational in the research evaluated; yet, the literature also shows that adoption is rarely straightforward. The question is not whether VR works in isolated contexts, but if it can be integrated in a sustainable, safe, and relevant way into real-world medical systems. This distinction is critical because a technology may provide great results in controlled trials while encountering significant opposition or limitations in ordinary clinical practice. In this regard, implementation should not be considered as a secondary concern, but rather as a determining factor in whether VR stays an experimental tool or becomes a permanent component of therapeutic care.

A significant problem noted in the literature is the disparity between short-term efficacy and long-term clinical validation. While several research show promising initial results, the evidence base is inadequate in terms of long-term impact and generalizability. For example, research on VR therapies for older persons with knee osteoarthritis emphasizes the importance of long-term follow-up measures, such as pain assessments, fall risk, psychological effects, and cybersickness [34]. The emphasis on trial protocols rather than completed long-term research reflects the field's early beginnings. This implies that implementation necessitates more than just initial success; it necessitates long-term evidence that VR interventions are effective, acceptable, and clinically useful across varied patient populations.

This issue is closely related to the difficulty of cost-effectiveness and resource allocation. The deployment of VR systems frequently necessitates substantial financial investment in hardware, software development, maintenance, and technical skills. While some studies demonstrate reduced patient discomfort and procedural burden, they also stress the importance of conducting complete cost-benefit evaluations to justify large-scale adoption [1]. In healthcare systems with limited resources, decision-making is influenced by both clinical effectiveness and economic feasibility. Without strong evidence that VR provides measurable benefit proportional to its cost, mass adoption is impossible. Thus, financial sustainability is a significant barrier to the transition from experimental to ordinary practice.

Another major constraint is technical usefulness and patient tolerance. Although immersion is commonly recognized as a key feature of VR, it can also cause dizziness, visual discomfort, weariness, and cybersickness [34]. These challenges are especially important for vulnerable populations, such as the elderly and individuals with pre-existing medical illnesses. In therapeutic settings, any technology that causes discomfort can undermine patient trust, involvement, and compliance. As a result, successful deployment necessitates careful consideration to ergonomic design, interface usability, and individual patient compatibility, ensuring that immersive environments are both clinically acceptable and user-friendly.

The literature emphasizes the relevance of training and user preparedness in ensuring successful deployment. VR systems require planned onboarding, frequent exposure, and directed engagement to yield meaningful results. Evidence suggests that increases in clinical performance are frequently related with ongoing training programs rather than one-time use [15]. Similar trends are shown in simulation-based studies, where prolonged participation over several months results in significant skill improvement. These findings imply that implementation is more than just deploying technology; it also entails creating an ecosystem that promotes continual learning and adaptation. In resource-constrained healthcare facilities, this necessity may present substantial logistical issues.

Furthermore, rather than serving as a single solution, VR is typically found to be most effective when used in conjunction with other systems. Studies show that VR-based interventions produce better results when combined with traditional methods like high-fidelity simulation, face-to-face engagement, or clinical practice [24,29]. While this connectivity improves efficiency, it also adds complexity since institutions must coordinate different systems and maintain alignment with existing operations. The difficulty is therefore orchestration rather than adoption alone, which necessitates smart integration techniques that embed VR inside broader therapeutic and educational systems.

A third constraint is the variability of evidence and the lack of standardization in VR research. Variations in study design, intervention kinds, outcome measures, and evaluation frameworks make comparability difficult and reduce the overall quality of the evidence base [9]. Even when good results are presented, variations in statistical significance and methodological rigor make interpretation difficult. Similar difficulties arise in patient-focused studies, where positive outcomes are frequently accompanied by significant variability among samples and circumstances [4]. This lack of standardisation undermines confidence in implementation decisions since stakeholders must navigate a fragmented and frequently inconclusive body of evidence.

The issue of transferability from virtual to real-world practice is likewise a major challenge. While VR environments can accurately recreate clinical scenarios, it is not always obvious if the abilities, behaviors, or emotional responses learned in virtual settings translate effectively into actual clinical performance [6]. Although studies show that VR can increase involvement and empathy, more study is needed to determine the long-term viability and practical implementation of these outcomes in real-world healthcare settings [31]. This disparity between virtual experience and clinical reality is a significant obstacle to adoption, as healthcare systems emphasize interventions with demonstrated real-world effectiveness.

Furthermore, the study highlights ethical and psychological concerns related with immersive technologies. If not adequately built, high-intensity simulations can cause emotional stress or psychological discomfort, especially in high-stakes or sensitive settings. Ethical concerns are also raised about the realism of virtual experiences and their possible impact on user perception and decision-making. These characteristics underscore the importance of responsible design techniques that prioritize user well-being, contextual relevance, and ethical integrity in implementation procedures.

Overall, the data indicates that implementation issues are critical predictors of whether VR may acquire therapeutic relevance in medical practice. These limitations include a lack of long-term evidence, high costs, technical difficulty, training demands, inconsistent findings, reliance on blended models, questionable transferability, and ethical complexities. The broad takeaway is that VR adoption necessitates a systems-level approach. Effective implementation is dependent not just on technological quality, but also on infrastructure, staff preparation, protocol creation, evaluation criteria, patient suitability, and financial sustainability. In this respect, the literature does not deny VR; rather, it advocates for a more disciplined and realistic approach to its implementation. The therapeutic future of VR in medical practice will be determined by healthcare systems' ability to

address the practical conditions that allow immersive therapies to function safely, reliably, and meaningfully in real-world care, rather than their enthusiasm for immersion.

Table 3
The theme and the key findings

Theme	Key Finding	VR Elements
Therapeutic Outcomes	VR consistently showed potential to reduce pain, stress, anxiety, and emotional distress during clinical or supportive care procedures.	Immersion, distraction, multisensory stimulation, calming virtual environments
	VR improved empathy, openness, and understanding of patient experience, especially in autism-related and patient-perspective simulations.	First-person simulation, perspective-taking, experiential immersion
	VR enhanced confidence, self-perceived competence, and mental health literacy in high-stress healthcare situations such as agitation management.	Scenario-based simulation, repeatable exposure, realistic clinical interaction
	VR improved patient comfort and satisfaction during minor surgical procedures and reduced anesthetic requirements in some settings.	Head-mounted display, real-time distraction, immersive relaxation content
	Evidence for anxiety reduction was promising in some contexts, but not always statistically consistent, especially in mock MRI applications.	Familiarisation environment, procedural simulation, preparatory immersion
	VR demonstrated value as a non-pharmacological adjunct in pediatric pain management, with consistent positive direction across multiple meta-analytic findings.	Immersive distraction, gamified engagement, visual-auditory attention capture
Clinical Applications	VR was widely applied in surgical and procedural training, including wound suturing, laparoscopic navigation, spine surgery, and thrombectomy skill development.	Procedural simulation, haptic feedback, 3D anatomical modelling, repetitive practice
	VR supported diagnostic accuracy and preoperative planning through interactive 3D visualization of complex anatomical abnormalities.	3D segmentation, immersive visualization, interactive clinical modelling
	VR was used in clinical communication training to strengthen confidence in emotionally difficult conversations and decision-making.	Conversational simulation, immersive role-play, interactive patient scenarios
	VR enabled interprofessional and emergency-response training by simulating teamwork, ward-based urgency, and time-critical decisions in safe environments.	Multi-user simulation, emergency scenario design, collaborative virtual environment
	VR supported dentistry and oral-maxillofacial training by improving procedural accuracy, speed, and clinical familiarity over repeated sessions.	Virtual learning platform, haptic interaction, real-time feedback, skill rehearsal
	VR was applied in image annotation and radiological refinement, improving precision and clinical usability when experts interacted with AI-generated outputs.	Immersive editing, expert-in-the-loop annotation, voxel-level interaction

Theme	Key Finding	VR Elements
	Mobile and accessible VR formats were shown to support scalable health-related education and knowledge improvement in wider community contexts.	Smartphone-based VR, portable delivery, accessible visualization
Implementation Challenges	Many studies highlighted the need for stronger long-term evidence, broader trials, and better generalisability before VR can be fully embedded in routine medical practice.	Longitudinal evaluation, controlled trials, evidence validation
	Technical barriers remained common, including cybersickness, eye strain, dizziness, latency, visual discomfort, and limited physical interaction.	Headset usability, motion sensitivity, display performance, interaction design
	High initial cost, maintenance demands, and uncertain cost-effectiveness were major barriers to wider adoption.	Hardware investment, software development, infrastructure support
	Successful use of VR often depended on clinician training, user readiness, and structured implementation rather than simple technology deployment.	Training protocols, guided onboarding, repeated supervised use
	VR was often most effective as a complement to conventional or blended approaches rather than as a full replacement for real-life practice.	Blended learning, scaffolded simulation, hybrid instruction
	Standardisation remained weak across studies, including inconsistent terminology, taxonomy, outcome measures, and evaluation frameworks.	XR/VR classification, protocol standardisation, outcome benchmarking
	Safety and infection control concerns emerged, especially regarding headset sanitation and possible contamination in high-risk clinical settings.	Shared headset hygiene, device sanitation, hospital-safe equipment design
	Policy and system-level gaps such as limited reimbursement, absent guidelines, and restricted patient access slowed sustainable implementation.	Clinical governance, reimbursement model, access support, policy framework

5. Discussion

This systematic literature review sought to investigate the therapeutic potential of virtual reality in medical practice, and the findings collectively show that VR is progressively emerging as a relevant complement to contemporary healthcare rather than merely a unique technological addition. Across the research evaluated, VR proved benefit in improving patient outcomes, broadening the spectrum of clinical uses, and enabling more immersive, interactive, and adaptable forms of intervention. At the same time, the assessment emphasizes that its promise is still conditioned by significant implementation constraints such as cost, standardization, usability, long-term validation, and institutional preparation. Taken together, the research reveals that VR's therapeutic potential in medical practice is to enhance conventional care through immersive, patient-centered, and clinically supporting roles, rather than to replace it.

The first key takeaway from this review is the importance of therapy results. According to the studies examined, virtual reality can help with pain treatment, stress reduction, anxiety management, emotional comfort, empathy development, and increased confidence in care-related

scenarios. These findings support the notion that therapy in medical practice should not be defined solely as pharmaceutical treatment or direct procedural intervention. Instead, therapeutic benefits include emotional stability, a better patient experience, increased relational sensitivity, and more helpful interactions between patients and healthcare professionals. In this regard, VR looks to be particularly useful because it operates on both sensory and psychological levels. Its immersive quality allows users to briefly detach from discomfort, fear, or distress while more actively participating in the therapeutic moment. This twofold effect is significant because it demonstrates a link between technological immersion and broader movements toward holistic, patient-centered treatment.

At the same time, the review recommends that therapeutic effects connected with VR should be read carefully. Some results were clear and quantitative, such as pain relief or fewer anesthetics, while others were indirect but clinically significant, such as increased empathy, improved communication confidence, and a better knowledge of the patient experience. This distinction is important because it expands our mental understanding of therapeutic value. A technology may not heal disease directly, but it can improve care quality by enhancing the emotional, cognitive, and relational qualities of medicine. This review thus supports the claim that VR should be viewed not only as a symptom-management tool, but also as an immersive medium capable of influencing how healthcare is perceived, delivered, and accepted.

The second key insight is found in the variety of clinical uses. According to the research, virtual reality is employed in a variety of healthcare scenarios, including surgical rehearsal, procedural training, communication practice, interprofessional teamwork, emergency response preparation, diagnostic support, and patient familiarization with daunting procedures. This breadth is one of VR's most significant advantages. Unlike more specialist technologies that serve a single therapeutic function, VR looks to be extremely adaptable across numerous medical disciplines. Its capacity to imitate clinical reality, give risk-free repetition, and provide interactive 3D worlds makes it ideal for jobs requiring spatial comprehension, procedural precision, or emotional preparation.

However, the wide range of uses creates an important interpretation issue. The current work frequently incorporates procedural training, education, therapeutic distraction, diagnostic planning, and communication development under the broad umbrella of VR in medicine. While this shows adaptability, it also results in conceptual overlap. Not all clinical applications of VR should be assumed to have the same therapeutic relevance. For example, a surgical simulator that increases procedural precision may have an indirect impact on patient outcomes, whereas immersive distraction during a painful surgery has a more immediate therapeutic benefit. Both are valuable, but they use distinct mechanisms. As a result, the therapeutic potential of VR may be better viewed as multifaceted rather than unique. It works directly in some circumstances and indirectly in others, but both types of contributions can be significant within the larger ecology of medical practice.

This multifaceted perspective is especially crucial for assessing the relationship between technological capabilities and actual therapeutic benefit. The examined research frequently state that immersive realism is insufficient. The efficacy of VR is determined by how well its application aligns with specific clinical goals. In some areas, including procedural simulation and surgical support, VR appears to have achieved a mature stage of development. In others, such as anxiety reduction prior to imaging procedures or broader use in normal care settings, the data is less consistent. This suggests that the future of VR in medicine will most likely be determined not by widespread enthusiasm for immersion, but by the careful matching of VR functions to clinically relevant challenges where its immersive capabilities provide true added benefit.

The third and possibly most important finding from this research concerns implementation issues. Almost all prospective VR applications are accompanied by practical concerns about sustainability, standardization, user acceptability, staff training, sanitation, cost-effectiveness, and regulatory

backing. These problems demonstrate that VR's effectiveness in medical practice is determined on more than just innovation. Instead, it relies on whether healthcare institutions can provide the organizational, technical, and ethical conditions required for its long-term usage. This is especially relevant in medical environments, which differ significantly from experimental or instructional settings. In healthcare, technologies must not only be interesting, but also safe, efficient, acceptable, and compatible with workflow requirements.

The issue of standardizing is very pressing. The examined studies differed greatly in terms of design, participant groups, intervention kinds, duration of exposure, outcome measures, and language. This heterogeneity makes it impossible to directly compare findings or establish which kind of VR use are the most clinically trustworthy. It also challenges efforts to develop robust evidence-based guidance. Without more standardized reporting and evaluation systems, the literature may continue to yield positive but fragmented results. This is one of the key issues found by the review: while VR appears promise in a variety of scenarios, its evidence base is not always cumulative enough to enable confident large-scale adoption.

Another implementation challenge is VR's reliance on supporting infrastructure and blended models. Several research indicate that VR works better when combined with other techniques rather than utilized alone. This suggests that successful deployment relies on intelligent system design rather than mere technology installation. Healthcare personnel may need onboarding and technical support, patients may need to be screened for tolerability or compatibility, and institutions may need to change workflows to incorporate VR effectively. In this context, the analysis predicts that the future of VR in medicine would rely on integrative solutions rather than stand-alone deployment. VR may be most beneficial when integrated into larger therapeutic, procedural, or educational settings that offer context, support, and continuity.

The analysis also addresses an essential question about the field's maturity. Much of the literature remains focused on feasibility, pilot results, and short-term benefits. This is understandable in a quickly expanding field, but it also highlights the need for more longitudinal and therapeutically based research. The primary question is no longer whether VR can deliver beneficial benefits in controlled settings, but if those results last over time, translate into routine practice, and justify the cost and complexity of deployment. Stronger follow-up studies, comparative effectiveness research, and real-world evaluations will be required if VR is to progress from potential novelty to established healthcare tool.

Overall, this research supports the notion that virtual reality has significant therapeutic promise in medical practice, particularly in domains involving patient experience, procedural support, emotional regulation, and immersive involvement. Its value is greatest when it is utilized to supplement and extend existing types of treatment rather than replacing them totally. At the same time, the report warns against making excessively jubilant interpretations. VR should not be viewed as a generally effective solution, but rather as a context-sensitive intervention whose success is dependent on alignment of technology design, therapeutic intent, and implementation readiness. The true value of VR rests not in its novelty, but in its ability to reimagine the therapeutic environment in ways that are immersive, sensitive, and perhaps more human.

In conclusion, the findings of this review indicate that virtual reality will play an increasingly essential role in the future of medical practice. It holds potential not only as a technological advancement, but also as a therapeutic medium capable of affecting how care is administered, perceived, and improved. However, its long-term significance will be determined by factors other than technological sophistication. It will be dependent on methodological rigor, institutional commitment, clinical validation, and the capacity to integrate immersive systems into healthcare in ways that are sustainable, ethical, and truly useful to both patients and practitioners.

6. Conclusion

This systematic literature review investigated the therapeutic potential of virtual reality in medical practice by synthesizing information from three major dimensions: therapeutic outcomes, clinical applications, and implementation challenges. According to the data, virtual reality is increasingly being recognized as more than just a technological novelty or additional digital tool. Instead, it is emerging as a valuable therapeutic medium capable of improving the patient experience, symptom management, clinical readiness, and the overall delivery of treatment. The evaluated research collectively imply that VR can benefit medical practice in both direct and indirect ways, spanning from pain and stress relief to increased communication, empathy, decision-making, and procedural assistance.

One of the primary results of this analysis is that VR's therapeutic potential stems from its multifaceted nature. Its immersive properties enable it to influence not just physical or psychological symptoms, but also the experiential aspects of healthcare, such as comfort, engagement, confidence, and trust. This makes VR especially important in a healthcare context that increasingly values patient-centered, holistic, and non-pharmacological approaches to intervention.

At the same time, the review shows that VR is extremely adaptable in its application. It has been applied to surgical and procedural training, diagnostic support, patient familiarization, rehabilitation, communication practice, and emotionally sensitive care settings. Such diversity demonstrates that VR is not limited to a single specialty or method of use, but rather functions as a flexible clinical resource with broad relevance across medical settings.

However, the review emphasizes that therapeutic potential may not always convert into sustainable implementation. Cost, technological discomfort, training needs, sanitation, evidence variability, and the lack of defined recommendations continue to be significant impediments to widespread adoption. These limitations indicate that the future success of VR in medical practice will be dependent not just on continuing technological improvement, but also on improved methodological consistency, long-term clinical validation, and institutional preparation. As a result, the field remains promising while still in transition, somewhere between innovation and integration.

Overall, this research indicates that virtual reality has the potential to significantly improve contemporary medical practice, particularly when utilized to supplement existing therapeutic and clinical approaches rather than replace them. Its long-term value will be determined by future research and healthcare systems' ability to move beyond initial enthusiasm and establish VR as a thoroughly studied, context-sensitive, and practically sustainable component of patient care. In this way, VR represents not merely a technology advancement in medicine, but also an opportunity to rethink how therapeutic settings are built, experienced, and enhanced in order to provide more effective and human-centered healthcare.

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