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Benefits and Challenges of Immersive Virtual Reality In Healthcare Training: An Integrative Review

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Abstract

Background: Immersive virtual reality is considered a promising tool to support healthcare training. However, its implementation faces several challenges.
Aim: This integrative review aims to systematically analyze the benefits and challenges associated with the use of immersive virtual reality in healthcare training.
Method: A comprehensive search was conducted across MEDLINE and CINAHL databases, targeting articles published between January 2015 and December 2024. A total of 139 studies were included and analyzed using NVivo, following a rigorous process of coding, categorization, and thematic synthesis.
Results: The findings reveal that immersive virtual reality supports cognitive and technical skill development, enhances emotional engagement, and provides practical advantages such as learning autonomy and risk-free practice environments. However, many limitations were identified, including technological challenges, pedagogical reservations, as well as physical or emotional discomforts such as cybersickness.
Conclusion: Further research should prioritize the creation of emotionally intelligent immersive virtual reality environments to fully optimize their educational benefits.
Keywords: Clinical skills development, Healthcare professionals, Healthcare training, Immersive virtual reality

INTRODUCTION

In recent years, the use of virtual reality (VR) in healthcare has increased significantly, creating new possibilities for diagnosis and treatment (Kouijzer et al., 2023). Particularly, immersive virtual reality (IVR) is gaining popularity in healthcare training, as shown by its growing use in health-related literature Saab et al. (2022).

The concept of immersive virtual reality (IVR) has been explored in research from many angles. According to Sturman et al. (2021), immersion in IVR happens when technologies enable users to perceive and feel as if they are within the virtual world. This definition highlights the sensory elements that are important to the immersive experience. Choi et al. (2022) reinforce this idea by focusing on IVR's ability to block out the physical world to ensure a deeper level of interaction compared to desktop VR. Bailenson (2018) and Shorey and Ng (2021) further clarify the technical distinction between IVR and other forms of virtual reality. In fact, IVR, viewed through a head-mounted display (HMD), fully immerses the user in a digital world, excluding the physical environment, whereas desktop-based VR offers a less immersive experience by confining interaction to a screen. Huang and Liaw (2018) extend these perspectives by highlighting IVR's ability to provide a safe space for users to develop their skills in simulated scenarios without associated risks. Considering these insights, Immersive Virtual Reality can be defined as a technology that fully immerses users in a three-dimensional digital environment using head-mounted-displays (HMD). This allows users to feel

their presence in the virtual environment and actively interact with it to develop their skills in an authentic, risk-free space.

The growing interest in IVR can also be noticed in the market, where the estimated investment in immersive technology in healthcare is exceeds $2.7 billion and is expected to triple by 2027 (Balasubramanian, 2022). Lundström and Fernaeus (2019) consider it as a revamp to the healthcare business, potentially reshaping healthcare training for future professionals. However, despite the potential added value of this technology, its implementation in clinical practice is still in its infancy and requires further studies (Kouijzer et al., 2023).

AIM

This integrative review aims to examine the benefits and challenges related to the use of IVR in healthcare training.

METHODS

To build the corpus for this integrative review we used the method of (Whittemore & Knafl, 2005). Scientific databases were systematically searched using search queries. These queries were developed with the support of a professional and experienced academic librarian to ensure alignment with the controlled vocabulary specific to each database. The search targeted peer-reviewed articles published in English or French between January 2015 and December 2024. This timeframe was selected to capture literature published after the release of the Hololens virtual reality device (Sung et al., 2024), which marked a milestone in immersive technology development. Studies were included if they focused on educational or training interventions involving nurses or physicians using fully immersive virtual reality technologies, in line with the definition adopted in this review. Thus, studies were excluded if they relied on non-immersive or semi-immersive virtual reality (e.g., desktop-based systems or augmented reality). The selection process was documented in a PRISMA flow diagram.

Table 1. Concepts and Search Terms Used for the Database Search

Concepts	Immersive virtual reality	Healthcare professionals	Training
Free-text search	(virtual N2 simulat*) "immersive technolog*" "virtual environment*" "virtual realit*" vr "virtual world*" "virtual space*" Metaverse Metaquest	allergist* anesthesiologist* anesthetist* cardiologist* dentist* dermatologist* diabetologist* doctor*	education "competencies development" learning Fieldwork* Internship* Residency "staff development"
MEDLINE	"Computer Simulation" "Avatar" "Virtual Reality"	"Physicians+" "Nursing Staff+" "Nurses+" "Dentists+" "Medical Staff+"	"Education" "Problem-Based Learning" "Self-Directed Learning as Topic" "Simulation Training+" "Inservice Training+" "Professional Competence" "Clinical Competence" "Education, Nursing+" "Education, Medical+" "Preceptorship" "Education, Continuing" "Education, Graduate" "Education, Nursing, Graduate" "Education, Medical, Graduate+" "Education, Dental+")Staff+"
CINAHL	"Computer Simulation" "Virtual Reality+"	"Nurses+" "Physicians+" "Students, Nursing+" "Students, Medical+"	"Education, Nursing, Continuing" "Education, Continuing (Credit)" "Education, Continuing" "Education, Medical+"

		"Students, Dental"	"Nurses+/ED" "Physicians+/ED" "Outcomes of Education" "Fieldwork" "Education, Baccalaureate+" "Education, Dental" "Education, Graduate+" "Education, Nursing" "Education, Nurse Anesthesia" "Education, Nurse Midwifery" "Education, Nursing, Associate" "Education, Nursing, Baccalaureate+" "Education, Nursing, Diploma Programs" "Education, Nursing, Graduate+" "Education, Nursing, Practical" "Education, Nursing, Research-Based" "Internship and Residency+" "Learning Methods" "Self-Directed Learning" "Experiential Learning" "Problem-Based Learning" "Staff Development" "Education"

An initial total of 3266 studies were identified through database searches, specifically MEDLINE (n = 1783) and CINAHL (n = 1481), in addition to 2 manually added ("cherry-pick") considered relevant to the topic. During the identification phase, 23 duplicate records were removed, 4 manually and 19 automatically by Covidence. This resulted in 3243 studies retained for title and abstract screening.

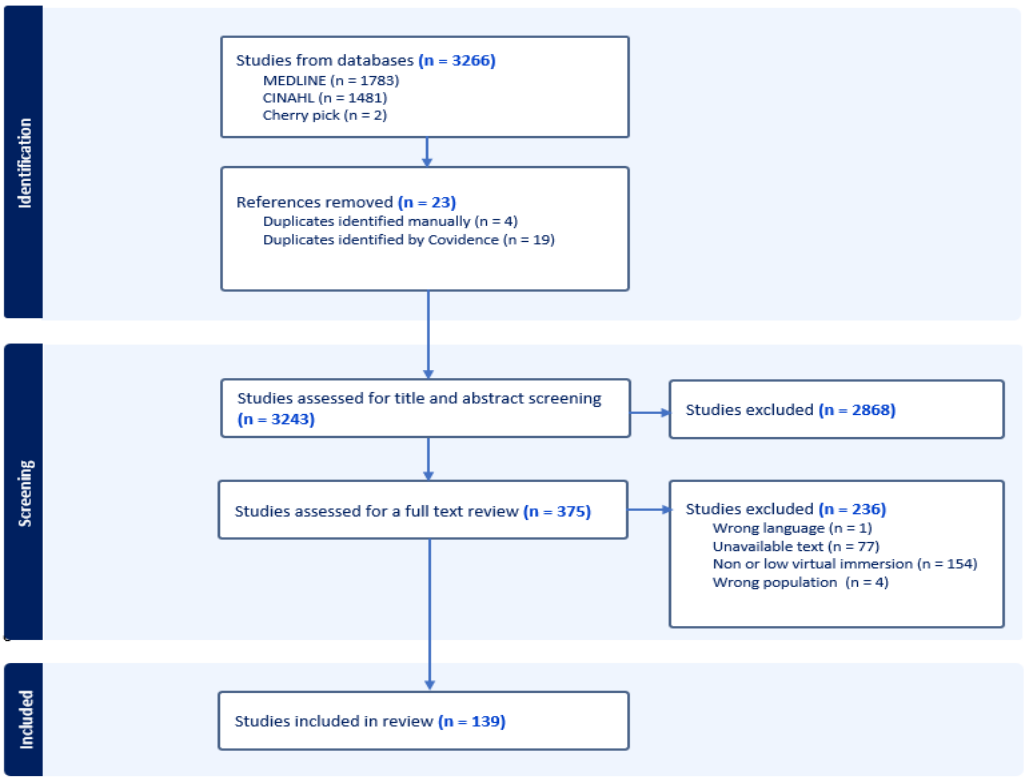

Figure 1. PRISMA flow diagram of the study selection process in Covidence

During the screening phase, 2868 studies were excluded due to irrelevance to the inclusion criteria based on title and abstract. The remaining 375 articles were then assessed for a full text review. Out of these, 236 studies were excluded for the following reasons: 77 texts were unavailable, as access was restricted, 154 referred to non-immersive or low-immersion technologies, rather than fully immersive virtual reality, 4 involved populations that did not meet the inclusion criteria, and 1 was written in a language not covered by the reviewers. After this selection process, 139 studies were included. These studies formed the basis of analysis regarding the use of immersive virtual reality in the training of healthcare professionals.

Data analysis

According to the method proposed by Whittemore and Knafl (2005), the interpretation and synthesis of primary studies in this review followed a systematic and rigorous method of qualitative analysis. This approach involved reducing the data, organizing it into meaningful categories, and comparing it to generate and validate conclusions. Building on the work of Kirkevold (1997), (Whittemore & Knafl, 2005) emphasized that the assessment of primary sources should consider factors such as authenticity, methodological quality, relevance of information, and representativeness. Following these principles, each selected article was critically analyzed.

The first stage of data analysis consisted of reducing the content to key elements: benefits and challenges of IVR use in healthcare training, to enable systematic comparison across studies. NVivo software was then used to facilitate the coding and organization of the data. All the articles were coded independently by a single researcher. A second researcher conducted verification at three points, after 20%, 70%, and 100% of the corpus had been coded, to ensure rigor throughout the process.

Based on this process, thematic categories were constructed, each grouping together codes sharing similar conceptual meanings. The resulting structure is presented in the following table.

Table 2. Categorization of identified codes during data analysis

Category	Sub-category	Codes
Benefits of IVR use in healthcare training	Cognitive and Technical Learning Outcomes of IVR	Decision-making and problem-solving Communication skill development Critical thinking development Knowledge development Academic score improvement Knowledge retention Instant feedback Error reduction Fast learning Technical skill enhancement
	Affective Outcomes of IVR	Engagement Motivation Empathy Increased confidence Enjoyability Reduced stress and anxiety User's acceptance User's satisfaction
	Practical Advantages of IVR	Interactivity Safe space for practice Bridging the gap between academic learning and practical application Familiarization with clinical cases Usability Cultural difference training Learner's autonomy Cost-effectiveness Low infrastructure necessity Space and time Flexibility

		Sense of presence Possibility of learning from mistakes Repeatability of practice Standardised learning Immersion Realistic experience
Challenges of IVR use in healthcare training	Technical and logistical limitations of IVR	Hardware limitations Software limitations Haptic feedback issues Cost of development Cost of instrument Cost of maintenance Infrastructural limitations Altered sense of realism Fine movement issues
	Pedagogical limits and reservations towards IVR	No significant academic improvement Skill transfer concerns Ethical considerations
	Physical and emotional challenges in IVR training	Cybersickness Visual problems Lack of balance Lack of verbal communication Lack of physical interaction Lack of emotional communication Difficulty adapting to IVR Emotional challenges Frequent exposure effects High cognitive load User's non acceptance

RESULTS

The selected articles meeting the inclusion criteria were uploaded on Covidence and analyzed in this review. Covidence is a reference management and screening tool designed for knowledge syntheses, and it includes data extraction features.

To ensure rigorous search, both free-text terms and controlled vocabulary (MEDLINE and CINAHL headings) were used. Table 1 presents the main concepts and the corresponding search terms across the databases.

The analysis of the selected studies highlighted a range of benefits and challenges associated with the use of immersive virtual reality (IVR) in healthcare training. The findings are organized into two main categories: the benefits of IVR use as well as its challenges.

Benefits of IVR use in healthcare training

The benefits of immersive virtual reality (IVR) in healthcare training, as explored in literature, can be organized into three sub-categories: cognitive and technical learning outcomes, affective outcomes, and practical advantages.

Cognitive and Technical Learning Outcomes of IVR

Immersive virtual reality (IVR) has proven to be an efficient tool for learning development (Adhikari et al., 2021). Research reported that IVR use helped visualize abstract concepts such as anatomy, morphology and pathology, improving diagnostic skills (Adhikari et al., 2021; Banerjee et al., 2023; Fairén et al., 2020). IVR also helped users better understand some specific clinical procedures such as Foley catheter insertion and NG tube feeding. They indicated that the simulations helped them memorize operational steps and reduced learning difficulties (Chang, 2022; Chao et al., 2021). Multisensory elements, such as visual and auditory, were described as reinforcing comprehension and making knowledge acquisition more vivid (Fairén et al., 2020; Girão et al., 2021; Rourke, 2020).

IVR-based learning also showed positive effects on learning retention (Birrenbach et al., 2023; Chang et al., 2024). Students indicated that the technology allowed them to retain correct procedural sequences seen in the immersion (Butt et al., 2018; Lau et al., 2023). Several studies confirmed that IVR also contributes to

the enhancement of technical and skills, such as knot tying (Andersen et al., 2023; Andersen et al., 2021), laparoscopy (Andersen et al., 2023), Foley catheter insertion (Chang, 2022). IVR users reported more precise movements, improved accuracy, and a better understanding of procedural steps (Chang, 2022; Huai et al., 2024; Mäkinen et al., 2023). Faster acquisition of cognitive and technical skills was frequently reported by users and supported by comparative performance metrics (Ahmed et al., 2023; Andersen et al., 2021; Kane et al., 2022; Lohre et al., 2020). In most cases, IVR learners completed tasks like glenoid exposure and knot tying significantly faster than those using videos or live simulations (Ahmed et al., 2023; Andersen et al., 2021; Collaço et al., 2021).

Improvements in critical thinking were noted across studies that used immersive virtual simulations (Jans et al., 2023; Kim et al., 2024; Yu & Mann, 2021). IVR helped learners enhance their judgment, problem-solving and reasoning (Lee & Baek, 2024; Rainford et al., 2023; Sim et al., 2022) particularly during urgent or complex scenarios (M. Yoon et al., 2024). Furthermore, decision-making and problem-solving were consistently supported by immersive IVR use (Hall & Walmsley, 2023; Hardie et al., 2020; Thomas, 2022; Yang & Oh, 2022). Participants noted the value of IVR in encouraging autonomy, simulating realistic clinical reasoning, and allowing repeated exposure to complex cases (Mills et al., 2020; Olasky et al., 2015; Shin et al., 2019).

The different benefits mentioned above were reflected in improved academic performance and reduced errors. In fact, nursing and medical students trained with VR obtained higher scores in theoretical and practical evaluations, including Objective structured assessment of technical skill (OSATS) and post-tests, when compared to control groups (Kane et al., 2022; Mousavi et al., 2022; Salameh et al., 2024). Improvement was also observed in midterm to final exam scores, and in task-specific metrics like cannulation success rates and clinical assessments (Andersen et al., 2021; Chang, 2022). Error rates across various clinical settings were reported to decrease (Huber et al., 2018; Keicher et al., 2024; Rossler et al., 2024). Learners trained with IVR committed fewer mistakes during simulation-based tasks, including anesthesia and medication administration (Collaço et al., 2021; Rossler et al., 2024).

Finally, in addition to technical and cognitive competencies, IVR was also found to improve communication skills, especially in nurse–patient interactions (Chen & Liou, 2022; Chou et al., 2024; D'Errico, 2021).

Affective Outcomes of IVR

Learners manifested good levels of satisfaction with IVR-based training (Abbas et al., 2020; Babaita et al., 2024). They mostly highlighted the ease of use of the virtual environments, which contributed to positive perceptions of the learning experience (Botha et al., 2021; Fu et al., 2024).

This sense of satisfaction was often associated to the enjoyment that users experienced while navigating the immersive environments. They revealed that IVR activities were exciting and fun (Chao et al., 2021; Foronda et al., 2016). The innovative and interactive design of the immersive environment helped maintain their concentration during the experience (Gamba & Hartery, 2024; Lohre et al., 2020). For many, the enjoyable nature of the activity played a role in stimulating enthusiasm toward learning (Plotzky et al., 2023; Rainford et al., 2023).

Therefore, this enjoyment contributed to stronger engagement and motivation during the learning (Bayram & Çalışkan, 2021). IVR environments encouraged active interaction and maintained focus (Bradley et al., 2024; Butt et al., 2018). In fact, learners reported feeling curious, stimulated, and more concentrated in comparison to traditional learning modalities (Hardie et al., 2020; Havola et al., 2021).

The sense of engagement reduced stress and anxiety for many users. In fact, immersive training enabled users to practice without fear of judgment (Chang & Lai, 2021; Salameh et al., 2024). Participants described feeling more relaxed in virtual environments than in face-to-face or mannequin-based simulations (Koskinen et al., 2024; Lavoie et al., 2024), therefore managing emotional pressure in clinical practice (Weyant et al., 2021; Wu et al., 2020).

This psychological ease also played an important role in building learners' self-confidence and sense of efficacy. In fact, allowing students to experience realistic environments, IVR helped them feel more competent in their skills (Banerjee et al., 2023; Birrenbach et al., 2023). Several participants even expressed that the guided immersion contributed to a progressive sense of self-efficacy (Raab et al., 2023; Roberts et al., 2024; Yeh et al., 2024).

In addition to boosting confidence, immersive experiences helped with empathy development for healthcare practitioners, particularly with vulnerable patients (Lau et al., 2023). Being placed in the patient's position allowed users to experience emotions such as fear, helplessness, and confusion, which influenced their own behavior (Roberts et al., 2024; Saab et al., 2021). Many participants stated that these experiences helped them adopt more humaine and compassionate attitudes (Efendi et al., 2023; J. J. Lee et al., 2023).

Practical Advantages of IVR

The use of immersive virtual reality (IVR) in healthcare training proved in many studies that it helps users to get familiar and prepared for clinical practice. They reported that IVR helped bridge the gap between theoretical knowledge and practical application (Jans et al., 2023; Lin et al., 2024). Several studies emphasized that IVR provided a risk-free setting for practice (Adhikari et al., 2021; Andersen et al., 2023) and direct feedback (Coughlin et al., 2022), allowing performance improvement (Huai et al., 2024).

The repeatability of IVR simulations was another important benefit. Users appreciated being able to retry procedures multiple times (Chou et al., 2024; Dong et al., 2024), which helps with building mastery through repetition (Yu & Mann, 2021). A strong sense of presence was also reported across studies, with participants expressing the feeling of better focus and involvement during sessions (Huber et al., 2018; Jacobsen et al., 2022). Participants found the scenarios and the avatars very realistic and authentic (Brown et al., 2023; Chang, 2022), helping them feel closer to real clinical situations (Goldsmith et al., 2023). IVR also promoted learners' autonomy by offering self-paced, independent practice without supervision (Sankaranarayanan et al., 2018; H. Yoon et al., 2024). Users appreciated the ability to control learning progression (Mäkinen et al., 2023; Thompson et al., 2020)

Another major benefit identified was the cost-effectiveness of IVR training. Several studies highlighted that IVR simulations are inexpensive compared to traditional methods (Bradley et al., 2024; Kim et al., 2024). Finally, IVR simulations contributed to standardized learning experiences. The technology offered the same framework, allowing equal assessment across training groups (Real et al., 2017).

Challenges of IVR use in healthcare training

Despite the numerous benefits of immersive virtual reality (IVR) in healthcare training, various studies have reported important challenges. These limitations are categorized into technical and logistical issues, pedagogical concerns, and physical and emotional barriers.

Technical and logistical limitations of IVR

One of the most reported limitations of immersive virtual simulations was the altered sense of realism experienced by users. They noted that IVR could not fully replicate the tactile, auditory, or situational elements essential to authentic and realistic clinical training (Siah et al., 2022; M. Yoon et al., 2024). Some spoke about the system failure to simulate accurate hand movements or resulted in unnatural sensations during the experience (Mattsson et al., 2023; Phillips et al., 2022). This gap in realism was closely tied to haptic feedback issues. Many users mentioned that the absence of tactile sensations, or reliance on basic controller vibrations, reduced the realism of fine motor skills like palpation, injection (Hall & Walmsley, 2023; Lohre et al., 2020), vein puncture or object manipulation (Piispanen et al., 2024; Souza-Junior et al., 2020). In several cases, instruments lacked pressure response or resistance, which made it difficult to practice procedures that rely on fine motor skills (Chang et al., 2024; Jacobsen et al., 2022).

Alongside these experiential issues, users and instructors cited, on one hand, various hardware-related limitations. Heavy or poorly fitted headsets led to physical discomfort during long use (Lin et al., 2024; Weiner et al., 2019). On the other hand, equally problematic were software limitations, which affected the functionality of many IVR training programs. Users described repeated technical glitches and lags (D'Errico, 2021; Lavoie et al., 2024).

These technical and experiential limitations were followed by significant financial limitations. The cost of instruments, including IVR headsets, compatible computers, and motion sensors, was seen as a barrier to accessibility, especially in underfunded institutions (Ahmed et al., 2023; Banerjee et al., 2023; Coughlin et al., 2022; George & Titus, 2024; Hoffman et al., 2023; Huber et al., 2018). Moreover, the cost of development was frequently cited as a major issue. Developing authentic and interactive content required extensive funding, resource collaboration, and continuous updates to keep simulations clinically relevant (Chang & Lai, 2021; Kiegaldie & Shaw, 2023; Koskinen et al., 2024; E. Lee et al., 2023). Finally, the cost of maintenance, including software updates, repairs, and human resource needs, was described as an ongoing burden that institutions are continuously facing (Ahmed et al., 2023; Coughlin et al., 2022; Koskinen et al., 2024; Rourke, 2020).

Pedagogical limits and reservations towards IVR

Several studies questioned the educational value of IVR. They claim that this technology does not consistently outperform traditional healthcare training methods. In various studies, no statistically significant differences were observed between IVR and face-to-face learning in terms of user's performance, procedural accuracy, or self-confidence (Andersen et al., 2021; Babaita et al., 2024; Chao et al., 2021). Despite the satisfaction that many users expressed, measured outcomes in knowledge acquisition, communication skills, and reasoning capacity sometimes remained equal to those achieved through demonstration videos or desktop simulations (Huai et al., 2024; Jeong et al., 2022; Traister, 2023; Yamaguchi et al., 2022; Yang & Oh, 2022). Some users expressed that IVR was not always more efficient, and that similar results could be obtained through more

accessible methods (Mills et al., 2020; Mousavi et al., 2022; Weyant et al., 2021; M. Yoon et al., 2024). Others said that his technology cannot replace the traditional off-line hands-on training (Fu et al., 2024; Li et al., 2024; Saab et al., 2022; Saab et al., 2023). Therefore, many studies mentioned the difficulties in integrating IVR training within existing curricula (Girão et al., 2021; Hoffman & Wu; Jallad et al., 2024).

In parallel, other concerns related to skill transfer emerged. Participants questioned whether procedural gestures practiced in IVR could be transferred and replicated with the same fluidity and confidence in real clinical environments (Chang & Lai, 2021; Sim et al., 2022).

Finally, few studies addressed some ethical considerations regarding users' mental health (Shin et al., 2019). They stated that instructors should stay aware of the possible ethical sensitivities that may arise with the use of immersive technologies (Thomas, 2022).

Physical and emotional challenges in IVR training

Cybersickness was frequently mentioned as a big challenge in IVR learning simulations (Babaita et al., 2024; Bradley et al., 2024; Chou et al., 2024; Efendi et al., 2023). Learners suffered from dizziness (Ahmed et al., 2023; Chao et al., 2021), nausea (Coughlin et al., 2022; Dyer et al., 2018; Flood, 2024), headaches (Chao et al., 2021; George & Titus, 2024; Thomas, 2022), and blurred vision (Chou et al., 2024; Huai et al., 2024; Plotzky et al., 2023). Studies reported that these symptoms may negatively affect the IVR learning experience (Bradley et al., 2024; Chou et al., 2024; Woon et al., 2021)and could even have an impact on physical safety (Bradley et al., 2024; Chao et al., 2021; Chou et al., 2024). Although some studies indicated that the symptoms were minimal or rare (Jacobsen et al., 2022; Kane et al., 2022; Plotzky et al., 2023; Wu et al., 2022), many concerns are still emerging regarding their impact on learning outcomes (Chou et al., 2024; Woon et al., 2021). Moreover, other discomfort issues, especially among eyeglass wearers, were also documented. In fact, the pressure from IVR headsets led to discomfort (Chae et al., 2023; Dyer et al., 2018; Rainford et al., 2023) and eye fatigue (Omori et al., 2023).

Beyond physical problems, users faced emotional challenges which were caused by virtual patients. In fact, many users found them scary (Mäkinen et al., 2023; Mattsson et al., 2023). Their rigid facial expressions were described as unsettling and rigid, which provoked stress and anxiety (Lin et al., 2024). Some users also found the IVR simulations very intense and overwhelming, pointing to the need for support or prebrief trauma alerts before exposure (Flood, 2024; Hall et al., 2024). Cognitive overload also complicated the learning experience (Andersen et al., 2023). The richness of the immersive environments sometimes overwhelmed users (Banerjee et al., 2023; Plotzky et al., 2023; Rainford et al., 2023; Rama et al., 2022). The excessive sensory input was described as a barrier to maintaining focus (Plotzky et al., 2023; Woon et al., 2021).

Limitations related to human interaction were also identified on several levels. First, users pointed out a lack of emotional immersion during IVR simulations. They noted that virtual patients failed to replicate realistic emotional expressions, leading to a sense of detachment and unrealism (Chang & Lai, 2021; Lavoie et al., 2024; Mills et al., 2020). This showed the inability of IVR environments to simulate compassion, empathy, or body language (Dong et al., 2024; Phillips et al., 2022; Willett et al., 2024). Second, verbal communication with virtual patients was reported as insufficient (Adhikari et al., 2021; Kiegaldie & Shaw, 2023). Users stated that IVR scenarios did not allow for realistic interactions, and that patient responses often felt rigid or artificial (Chang & Lai, 2021; Liaw et al., 2023). Some participants expressed concern that these limitations hindered the development of their clinical communication skills (Dong et al., 2024; Mattsson et al., 2023; Plotzky et al., 2021; Plotzky et al., 2023; Saab et al., 2021; Shin et al., 2019). Third, the lack of physical interaction was also perceived as a challenge. Participants noted that IVR simulations offered few opportunities for hands-on or tactile experience with patients (Adhikari et al., 2021; Koskinen et al., 2024). They stated that this made the experience less efficient in comparison with other training settings such as high-fidelity simulations (Yu & Mann, 2021).

Finally, adaptation to the technology was itself another important issue. Users, especially those without prior IVR experience, struggled to navigate the platforms and needed time to become familiar with it (Adhikari et al., 2021; Bayram & Çalışkan, 2021; Bracq et al., 2019; Rainford et al., 2023). This led to them feeling some kind of frustration, confusion, and lack of confidence in the beginning of the experience (Koskinen et al., 2024; Mattsson et al., 2023; Siah et al., 2022; H. Yoon et al., 2024).

DISCUSSION

This integrative review illustrates the potential of immersive virtual reality (IVR) to improve healthcare training, while also outlining its major limitations. The findings confirm that IVR helps cognitive, technical, and emotional development by improving critical thinking, decision-making, communication skills, learning engagement, and self-confidence for healthcare professionals. Other practical advantages such as risk-free

environments, learning autonomy, and cost-effectiveness reinforce the technology's value for healthcare training. However, some challenges persist. Technical limitations, Pedagogical reservations, and other physical and emotional challenges constrain the impact of IVR.

Emerging initiatives like the Virtual Care Unit offer promising pathways to address these limitations. Developed by researchers at the University of Quebec at Rimouski (UQAR) in partnership with other Quebec universities and clinical institutions. It consists of a fully digital hospital environment offering training scenarios designed to support healthcare professionals in developing clinical surveillance mastery as well as interprofessional collaboration skills. This project aims to better prepare university and college healthcare students for future clinical placements in Quebec hospitals. The initiative promotes active learning and skill development through an innovative and immersive educational solution that replicates authentic clinical settings.

CONCLUSION

This review aimed to explore the benefits and challenges of IVR use in healthcare training in a rigorous synthesis of contemporary research across different disciplines. Nevertheless, it is limited by potential publication bias as the text selection included only database articles and stopped in 2024 whereas the rapid technological evolution may have outpaced current findings. Future research should prioritize the development and the validation of IVR environments that not only simulate clinical procedures but also incorporate emotionally intelligent patient interactions. This would allow users to fully experience the potential of IVR and to promote more intelligent clinical practice.

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