Saudi Journal of Medicine and Public Health

https://saudijmph.com/index.php/pub

https://doi.org/10.64483/jmph-170

The Virtual Frontier: A Systematic Review of the New Nursing Role in Integrating, Dispensing, and Ethical Stewardship of Virtual Reality for Therapeutic Use with Patients and Clinical Education

Khalid Abdullah Mudaysh Bajawi [(1)] , Abdullah Mussa Ahmad Sairafi [(1)] , Abdulrahman Abdullah Najdi [(1)] , Aqeel Mohammed Ahmed Majmi [(1)] , Yahya Atiah Hassan Faqihi [(1)] , Hawraa Abdulhadi Haashim Alsadah [(2)] , Nouf Nasser Abdulaziz Almulhim [(2)] , Zainab Abdullah Alburayh [(2)] , Fatimah Yousef Abdullah Alobud [(2)] , Sawsan Hussain Mohammed Alawad [(2)] , Rawan Fahad Abdultif Alzuwayyid [(2)] , Rawan Abdulrahman Al Marzooq [(2)] , Asala Hamdan Alruwaili [(2)] , Fatimah Yassen Abdullah Alalawi [(2)]

(1) Jazan Health Cluster - Ahad Al Masarihah General Hospital,Ministry of Health, Saudi Arabia
(2) Maternity and Children's Hospital, Alhassa, Saudi Arabia

Abstract

Background: Virtual Reality (VR) has become a valuable therapeutic and educational tool in healthcare, leveraging its capacity to create immersion and controlled environments for pain management, rehabilitation, mental therapy, and clinical training. In spite of this promise, the specific contribution of the nursing profession to the application and management of VR has been underemphasized in the literature.

Aim: The aim of this review is to synthesize literature from 2015 to 2024 to explore the nursing function within the VR environment in all its dimensions, with a particular focus on therapeutic applications, practical responsibilities in VR organization, and nursing application of VR in learning.

Methods: A systematic review of the primary academic databases (PubMed, CINAHL, PsycINFO) for English-language literature published between 2015 and 2024 was employed to undertake a narrative review. Search keywords were virtual reality, nursing role, patient therapy, and nursing education.

Results: The review supports the efficacy of VR in several clinical disciplines and presents the emerging role of the nurse as clinical advocate, VR administrator, safety officer, and outcomes evaluator. The review also identifies VR as a groundbreaking tool in nursing education and observes such prevailing challenges as practical hindrances, patient safety concerns like cybersickness, and ethical issues related to data confidentiality and fair access.

Conclusion: Nurses are central to the safe, effective, and ethical application of VR in healthcare. Reaching its full potential relies on defining the nursing role with targeted education, development of clear clinical procedures, and policy that facilitates its sustained and equitable integration into routine practice.

Keywords: virtual reality, nursing role, immersive simulation, patient safety, nursing education

1. Introduction

The contemporary healthcare context is characterized by the rapid convergence of digital technologies with the objectives of improving patient outcomes, maximizing therapeutic benefits, and streamlining clinical operations. Of these technologies, Virtual Reality (VR) has been a highly promising one. As a machine-generated simulation of a three-dimensional environment that can be engaged with in an apparently real or physical way through the use of specific electronic gear, VR offers a previously unachievable degree of presence and immersion (Kim et al., 2017; Deng et al., 2023). It is being applied throughout the spectrum of healthcare applications, from distracting patients through discomforting procedures to enabling a safe, replicable environment for motor relearning of skills and exposure therapy.

The new body of research is primarily concerned with technological validation and patient outcome, which ignores the critical human element of its delivery: the healthcare provider. Here, the nursing profession is a prime player. Nurses are not passive observers to technological progress; they are the primary coordinators of patient care, the first to assess patient condition, and the most respected practitioners of health by the general public (Nault & Thau, 2022). Their role in the VR process—spanning from patient selection and preparation to observing for side effects and determining therapeutic response—is complex and critical. But this role remains poorly defined,

*Corresponding author e-mail: kbajawe@moh.gov.sa (Khalid Abdullah Mudaysh Bajawi).
Receive Date: 30 November 2024, Revise Date: 30 December 2024, Accept Date: 31 December 2024

under-researched, and not a part of most standard nursing curricula (Dolan et al., 2021).

This review, therefore, seeks to fill this gap by a critical examination of how the role of nursing is evolving in embracing VR for the treatment and education of patients. It aims to: 1) synthesize the evidence of the effectiveness of VR in key therapeutic areas managed by nurses; 2) determine the specific competencies and tasks that administering VR should entail for it to be safely and effectively transferred to nurses; 3) explore the use of VR as a pedagogical tool for nursing education; and 4) outline the challenges and research directions, education, and policy to comprehensively integrate VR into everyday nursing practice.

Methodology

This is a narrative literature review of the nursing role in Virtual Reality (VR) implementation. A systematic search strategy was employed by way of using the main academic databases, including PubMed, CINAHL, PsycINFO, Scopus, and Web of Science. The search was conducted for peer-reviewed, English-language articles from 2015 up to 2024 to gain the most recent updates on consumer-grade VR technology and its clinical applications. Keywords and Boolean operators applied: ("Virtual Reality" OR "VR" OR "immersive simulation") AND ("nurs*", "nursing role, nursing care, OR nursing education) AND ("patient therapy" OR "pain management" OR "rehabilitation" OR "mental health" OR "training"). The reference lists of the articles obtained from the search were also hand-searched for additional relevant sources.

The initial search revealed over 600 publications. Titles and abstracts were screened for applicability to the main themes of the review, specifically studies that mentioned the process of implementation, clinical administration, or nursing perception regarding VR, rather than merely reporting patient outcomes in isolation from the delivery mechanism. Non-immersive screen-based simulation and augmented reality articles were excluded. 85 sources were retrieved in full text and of which 40 are referred to in this paper to buttress the synthesis and analysis of findings.

The Evidence Base for VR in Patient Therapy: A Nursing Perspective

The evidence for therapeutic applications of VR is widespread and growing, and for many of the significant areas, there is a strong evidence base to support its use. Nurses need to understand this evidence in order to facilitate appropriate patient selection, advocacy, and informed application.

Pain and Anxiety Management

One of the most well-established applications of VR involves its use in acute pain and procedural anxiety management. The mechanism is mainly founded on the gate control theory of pain and the theory of immersive distraction. Through the ability to access several sensory channels (visual, auditory, and sometimes haptic), VR gains high attentional requirements, leaving lower levels of mental capacity for pain signal processing (Indovina et al., 2018; Esposito et al., 2022). Numerous RCTs have demonstrated effectiveness. For instance, VR has been found to reduce pain and anxiety related to wound care in patients with burns (Son et al., 2022; Lan et al., 2023), venipuncture in children (Litwin et al., 2021; Chang et al., 2022), and dental procedures (Felemban et al., 2021). From a nursing perspective, this is a very potent non-pharmacological adjunct to traditional analgesics and has the potential to reduce opioid use and its side effects. The nurse's job is to select patients who will benefit, select the appropriate immersive content (e.g., calming settings vs. interactive games), and monitor the patient's subjective experience during the treatment.

Physical and Neurological Rehabilitation

Physical rehabilitation isbeing revolutionized by VR through enjoyable, task-specific, and quantifiable training for stroke, spinal cord injury, or orthopedic trauma patients. VR systems have the ability to provide immediate feedback, adaptively change task difficulty, and simulate actual-world activities in a safe environment (Laver et al., 2018; Saposnik, 2016). In stroke survivors, VR treatment has been superior to conventional therapy alone at improving upper and lower limb function, balance, and activities of daily living (Lee et al., 2016; Shin et al., 2016). Rehabilitation unit nurses are at the forefront of this. They supplement prescribed exercises by physical and occupational therapists, facilitate compliance, and use data from VR sessions to measure patient progress and motivation. They also monitor patient safety during VR use, inhibit falls, and manage any cybersickness effects (Yamato et al., 2016).

Mental Health and Exposure Therapy

In mental health nursing, VR is a structured medium for exposure therapy, social skills training, and mindfulness. For phobic patients (e.g., acrophobia, agoraphobia), posttraumatic stress disorder (PTSD), or anxiety disorders, VR provides incremental, replicable, and controlled exposure to feared stimuli under the direction of the therapist (Riches et al., 2021; Schroeder et al., 2022). Psychiatric-mental health nurses can co-facilitate such sessions, guiding and supporting during virtual exposure. Moreover, VR-based relaxation and mindfulness applications are also being used to treat depressive symptoms and stress, which may be delivered by nurses as part of an integrative care plan (Navarro-Haro et al., 2017; Sigmon et al., 2023).

The Growing Role of the Nurse in VR Implementation and Administration

The successful implementation of Virtual Reality in clinical settings is a complicated undertaking beyond the availability of the technology

itself; instead, it is completely dependent upon the human experience and procedural scaffolding to enable its use. Nurses, who are at the pivotal intersection of patient care and the use of technology, are spearheading this change. Their role is rapidly expanding from passive recipients to active, central participants in the VR continuum of care, a process that increasingly is being institutionalized in clinical practice and job descriptions. This change entails many areas of great importance where nursing science is essential.

Clinical Advocate and Patient Educator

Since patients' most consistent contact, nurses are central advocates for and educators about new therapies like VR. This role begins by demystifying the technology for often anxious patients and relatives. Nurses must communicate the therapeutic basis in a format easily understood by patients and relatives, outlining, for instance, how profound distraction can modify perception of pain or how a virtual world can provide a safe environment to practice body movement. It is essential for teaching about managing expectations and securing buy-in. It involves working with anticipated concerns beforehand, such as technophobia, anxiety of losing control, or the chance for cybersickness, and thereby reducing anxiety and forming a therapeutic relationship (Hackenberger, 2023). Moreover, the nurse's presence during the informed consent process is crucial so that it is not merely a signature on paper but an actual dialogue that discusses the unique aspects of immersive technology, for example, data safeguarding, the risk of discomfort, and the patient's right to terminate or stop the session at any time.

VR Administrator and Safety Officer

The daily, experiential provision of VR therapy is increasingly the province of nursing practice. Such operating responsibility requires a new type of skill, such as technical proficiency to set up hardware, conduct routine troubleshooting, ready equipment for sanitizing and charging, and select appropriate software programs that are tailored to address the particular patient's clinical goals, cognitive abilities, and comfort preferences. However, the most critical function here is that of a dedicated safety officer. Unlike with an independent unit of hardware, a VR session requires vigilant, vigilant oversight. The patient needs to be closely observed by the nurse for any sign of adverse effects, such as cybersickness, which may take the form of pallor, perspiration, nausea, or dizziness (Li et al., 2023). They must also be aware of signs of psychological distress, like increased agitation or anxiety, that can be triggered by the virtual content.

Meanwhile, the nurse also ensures the physical safety of the patient in the real world, with an unobstructed open area for preventing falls or stumbles, and is prepared to physically escort or support the patient, as needed. The nurse has the last word to interrupt or terminate a session immediately in the event of any safety concerns, balancing the therapeutic potential of technology against the precedence of patient welfare.

Clinical Assessor and Outcome Evaluator

Nurses utilize their unrivaled clinical assessment skills to determine the effectiveness of VR. They can read faint, qualitative cues that technology in itself may not recognize, such as levels of patient interest, examples of frustration or occasions of insight and comprehension, and pain or relaxation cues that are non-verbal. By integrating the subjective nursing observations with the objective data generated by the VR system—e.g., quantitative range of motion, reaction time, or task accuracy—the nurse can build an integrative and informed evaluation of the intervention impact (Bauce et al., 2023; Ferguson et al., 2015). This combined assessment is essential for measuring session efficacy, giving prompt feedback to the therapy and enabling online adjustment of the treatment, and giving rich qualitative feedback to the broad interdisciplinary team, including physicians and therapists, to guide the overall direction of care. This role brings the nurse above the position of technology operator to that of an active interpreter of patient response to a novel treatment modality (Table 1 & Figure 1).

Table 1: Nursing Duties and Clinical Issues Across the Virtual Reality Therapy Process

Phase of Care	Nursing Role & Responsibilities	Key Considerations
Pre-Session Assessment & Planning	- Screen patients for appropriateness (contraindications, anxiety, willingness). - Assess for risk factors for cybersickness. - Select VR content aligned with therapeutic goals. - Educate the patient and obtain consent.	Patient comorbidities (e.g., seizures, severe glaucoma), cognitive status, and personal preferences must be evaluated.
Session Setup & Initiation	- Ensure hardware is sanitized and functional. - Set up a safe physical environment (clear space, secure cables). - Properly fit the head-mounted	Adjust head straps to distribute weight evenly; ensure correct interpupillary distance (IPD) for visual comfort.

	display (HMD) for comfort and clarity. - Provide clear instructions on use and safety.	
In-Session Monitoring & Intervention	- Continuously monitor the patient for adverse effects (cybersickness, distress). - Provide verbal coaching and encouragement as needed. - Ensure patient safety and prevent falls. - Document patient responses and any issues.	The nurse must remain physically present and engaged; avoid leaving the patient unsupervised.
Post-Session Evaluation & Documentation	- Debrief with the patient about their experience. - Assess for any latent effects of cybersickness. - Document session details, patient tolerance, and perceived efficacy. - Communicate findings with the interdisciplinary team.	Use structured tools or simple scales to quantify patient-reported outcomes and symptoms.

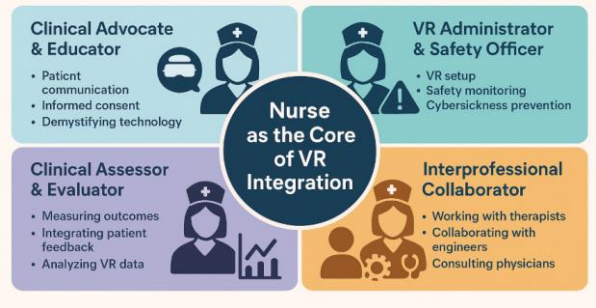

Figure 1: The Expanding Role of Nurses in Virtual Reality Therapy

VR as a Force of Change in Nursing Training and Education

The application of Virtual Reality extends beyond its immediate use in the care of patients into the foundational realms of nursing education, where it is being revealed as a profoundly transformative instructional tool. In developing highly immersive and interactive learning environments, VR offers experiences that are logistically burdensome, ethically problematic, or economically prohibitive to replicate on a regular basis within traditional simulation labs or clinical practicum. This type of technology innovation is transforming the education of future nurses, from the simple acquisition of knowledge to the development of deep, experiential mastery.

Immersive Clinical Skills and Procedure Training

One of the primary benefits of using VR for nursing education is that it can create limitless, risk-free practice of skills. Students can recycle practice for a multitude of procedures, ranging from fundamental skills like sterile gloving and drug administration to high-acuity, low-frequency interventions like ACLS or central line placement. This virtual environment achieves mastery learning, whereby students practice to a standard level of competence without fear of hurting a real patient or the cost and hassle of consumable mannequins and supplies (Cant et al., 2023). Pedagogical significance is great; meta-analyses have proven that VR-based training will lead to greater improvement in psychomotor skills, clinical judgment, and retention of knowledge over the long term than traditional lecture-based methods (Efendi et al., 2023). Furthermore, VR simulations can provide immediate, objective feedback on performance—e.g., hand path effectiveness or sequence correctness—so students receive precise feedback for self-enhancement.

Developing Non-Technical and Empathic Skills

To my way of thinking, the richest possible potential of VR in nursing education lies in its ability to support the most important, but difficult-to-teach, non-technical skills. Virtual simulations can be designed to represent complex, dynamic clinical scenarios that require students to exercise clinical judgment, set priorities, delegate, and communicate well with a team of healthcare providers represented as avatars, family, and the virtual patient itself (Chae et al., 2021; Moyer, 2023). This encourages critical thinking within an active, pressured environment that is representative of real-world clinical demands. As well as decision-making and working in teams, VR is a powerful agent for promoting empathy and person-centered care. By using "empathy VR" experiences, students are placed virtually in the patient's place with diseases like macular degeneration, dementia, or hearing loss and can feel for themselves the disorientation, frustration, and sensory losses that characterize them (Gutiérrez-Puertas et al., 2021; Saab et al., 2022). An embodied perspective can eliminate assumptions and provide a richer, more intuitive understanding of the patient experience, directly

leading to more empathetic and better clinical interactions.

Challenges, Barriers, and Ethical Concerns

While it is rich with potential, the widespread and long-term integration of VR into nursing practice and education is confronted with a series of significant challenges that must be actively acknowledged and overcome.

Practical and Financial Challenges

The upfront cost of high-fidelity VR equipment, recurring software licensing costs, and supporting IT infrastructure may be too expensive for resource-limited institutions or nursing schools. Aside from initial costs, implementing it poses operational issues. Nurses' time to equip the technology, train patients, supervise during sessions, and extensively clean between uses adds a considerable amount to clinical workloads. If this period is not legislatively recognized and accounted for in staffing plans and measures of productivity, it can cause workflow inefficiencies and burnout of nurses (Connor et al., 2020). Across this is the pace of technological obsolescence, which compromises long-term investments and makes standardization of training and procedures within a healthcare system challenging.

Health, Safety, and Adverse Effects

The user experience is not always pleasant, however, as cybersickness, a kind of motion sickness typified by nausea, dizziness, and oculomotor discomfort, remains a common side effect. This can limit session duration and tolerability in a notable percentage of patients and students and potentially keep them from the benefits of the technology (Ang & Quarles, 2023). Safety is also another need; face and hair contact for head-mounted display (HMD) sharing necessitates robust, easy-to-apply disinfection protocols to prevent the transmission of pathogens. Furthermore, the high psychological presence of VR necessitates special consideration, as content has the potential inadvertently to induce anxiety, re-traumatization, or other forms of psychological disturbance, especially in vulnerable individuals, and therefore needs careful monitoring and sensitive debriefing.

Ethical and Equity Considerations

The integration of VR raises new ethics that the nursing practice must help guide through. The technology tends to capture personal biometric and performance data, raising consequential patient and student data ownership, privacy, and security issues (Adams et al., 2021; Shevchuk et al., 2021). There is also a real risk of a "digital divide" in which access to sophisticated VR therapies becomes a health disparity indicator, benefiting patients in well-resourced, urban academic medical centers over patients in rural or underserved environments (Shevchuk, 2023). At a philosophical level, nurses must ensure that they are stewards of the therapeutic relationship so that VR is employed as a tool to enhance human touch and clinical skill, but not to negate the requisite empathy, touch, and presence that constitute the quintessence of nursing practice (Table 2 & Figure 2).

Table 2: A SWOT Analysis of Virtual Reality Integration in Nursing Practice and Education

Strengths ***(Internal, positive factors)***	**Weaknesses** ***(Internal, negative factors)***
• **Enhanced Therapeutic Outcomes:** Provides powerful, evidence-based non-pharmacological relief for pain and anxiety. • **Engaging Rehabilitation:** Increases patient motivation and adherence to repetitive physical and cognitive therapies through gamification and immersion. • **Superior Training Modality:** Offers a safe, repeatable, and scalable environment for practicing high-risk skills and complex clinical judgment. • **Professional Role Expansion:** Fosters the development of new nursing competencies in technology integration and digital health, enhancing professional stature.	• **Substantial Financial Outlay:** High initial costs for hardware and software, with ongoing expenses for maintenance and updates. • **Workflow Integration Challenges:** Requires significant nursing time for setup, patient education, monitoring, and cleaning, which can disrupt existing workflows. • **User Adverse Effects:** Cybersickness can limit utility and accessibility for a portion of the patient and student population. • **Rapid Technological Obsolescence:** Creates challenges for long-term budgeting, standardization, and content sustainability.
Opportunities ***(External, positive factors)***	**Threats** *(External, negative factors)*
• **Development of Advanced Roles:** Creates opportunities for new nursing specialties (e.g., VR Therapy Coordinator, Clinical Simulation Informaticist). • **Interprofessional Collaboration:** Catalyzes deeper teamwork between nursing, therapy, IT, and clinical engineering.	• **Exacerbation of Health Inequities:** Could widen the "digital divide," making advanced care accessible only to privileged populations. • **Ethical and Privacy Breaches:** Risk of mishandling sensitive patient data generated within VR platforms.

- **Nursing-Led Research:** Opens vast avenues for nurse scientists to lead studies on VR efficacy, implementation science, and patient experience.
- **Elevated Patient Satisfaction:** Can significantly improve the patient experience by reducing suffering and increasing engagement in care.
- **Dehumanization of Care:** Potential for technology to erode the humanistic, empathetic core of nursing if used as a substitute for interaction.
- **Implementation Burnout:** Without proper support, the added responsibility could contribute to increased stress and burnout among nursing staff.

Figure 2: SWOT Analysis of VR Integration in Nursing Practice

Recommendations and Future Directions

To achieve the maximum potential of VR in nursing, a strategic and collective effort is needed. Curriculum for nursing education needs to be overhauled to include digital health literacy, with a focus on principles, application, and administration of VR in modules. Practice using the technology and case-based education regarding patient selection and monitoring must be included (Foronda et al., 2020). Continuing education and certification for practicing nurses are equally crucial to upskill current employees. Nursing science needs to move on from efficacy studies to implementation science (Smith et al., 2022; Shorey & Ng, 2021; Demeco et al., 2023). There is also a need for qualitative research into the lived experience of nurses using VR.

Facilities must create clear policies and standardized processes for clinical use of VR, including hygiene, education, documentation, and safety. It would require the creation of new billing codes and value-based care paradigms that reimburse nurses for the time spent in administering VR therapy. Investment in VR must be coupled with investment in nursing education and role development to ensure effective implementation (Bargeri et al., 2023).

Conclusion

Virtual Reality is a paradigm shift in treatment and clinical education, offering immersive experiences with established benefits for patients and learners. By this review, it has been clearly established that nursing is not a bystander to this technological transition but is, in fact, at the heart of its safe, effective, and ethical integration into healthcare. Nurses are clinical champions, skilled managers, vigilant safety administrators, and astute assessors of VR treatment. They stand to benefit equally from VR as a groundbreaking tool for their own education and training. There is much to be done, however, along the lines of cost, workflow, safety, and ethics. It will require concerted effort to institutionalize the nurse role through education, research, and intentional policy. With the embrace of this evolving responsibility, the nursing profession can ensure that the interactive edge of VR is explored in a way that promotes patient safety, optimizes outcomes of therapy, and supports fundamental values of caring, person-centered practice.

References

1. Adams, D., Bah, A., Barwulor, C., Musaby, N., Pitkin, K., & Redmiles, E. M. (2018). Ethics emerging: the story of privacy and security perceptions in virtual reality. In *Fourteenth symposium on usable privacy and security (SOUPS 2018)* (pp. 427-442). https://www.usenix.org/conference/soups2018/presentation/adams
2. Ang, S., & Quarles, J. (2023). Reduction of cybersickness in head mounted displays use: A systematic review and taxonomy of current strategies. *Frontiers in Virtual reality*, *4*, 1027552. https://doi.org/10.3389/frvir.2023.1027552
3. Bargeri, S., Scalea, S., Agosta, F., Banfi, G., Corbetta, D., Filippi, M., ... & Gianola, S. (2023). Effectiveness and safety of virtual reality rehabilitation after stroke: an overview of systematic reviews. *EClinicalMedicine*, *64*. https://doi.org/10.1016/j.eclinm.2023.102220
4. Bauce, K., Kaylor, M. B., Staysniak, G., & Etcher, L. (2023). Use of theory to guide integration of virtual reality technology in nursing education: A scoping study. *Journal of Professional Nursing*, *44*, 1-7. https://doi.org/10.1016/j.profnurs.2022.10.003
5. Cant, R., Ryan, C., & Kelly, M. A. (2023). Use and effectiveness of virtual simulations in nursing student education: An umbrella review. *CIN: Computers, Informatics, Nursing*, *41*(1), 31-38. *DOI:* 10.1097/CIN.0000000000000932
6. Chae, D., Yoo, J. Y., Kim, J., & Ryu, J. (2021). Effectiveness of virtual simulation to enhance cultural competence in pre-licensure and licensed health professionals: A systematic review. *Clinical Simulation in Nursing*, *56*, 137-154. https://doi.org/10.1016/j.ecns.2021.04.013
7. Chang, Z. Y., Kang, G. C. Y., Koh, E. Y. L., Fong, R. J. K., Tang, J., Goh, C. K., & Tan, N. C. (2022).

Immersive virtual reality in alleviating pain and anxiety in children during immunization in primary care: a pilot randomized controlled trial. *Frontiers in pediatrics*, *10*, 847257. https://doi.org/10.3389/fped.2022.847257

8. Connor, K. I., Siebens, H. C., Mittman, B. S., Ganz, D. A., Barry, F., Ernst, E. J., ... & Vickrey, B. G. (2020). Quality and extent of implementation of a nurse-led care management intervention: care coordination for health promotion and activities in Parkinson's disease (CHAPS). *BMC health services research*, *20*(1), 732. https://doi.org/10.1186/s12913-020-05594-8
9. Demeco, A., Zola, L., Frizziero, A., Martini, C., Palumbo, A., Foresti, R., ... & Costantino, C. (2023). Immersive virtual reality in post-stroke rehabilitation: a systematic review. *Sensors*, *23*(3), 1712. https://doi.org/10.3390/s23031712
10. Deng, Z., Xiang, N., & Pan, J. (2023). State of the art in immersive interactive technologies for surgery simulation: a review and prospective. *Bioengineering*, *10*(12), 1346. https://doi.org/10.3390/bioengineering10121346
11. Dolan, H., Amidon, B. J., & Gephart, S. M. (2021). Evidentiary and theoretical foundations for virtual simulation in nursing education. *Journal of Professional Nursing*, *37*(5), 810-815. https://doi.org/10.1016/j.profnurs.2021.06.001
12. Efendi, D., Apriliyasari, R. W., Prihartami Massie, J. G. E., Wong, C. L., Natalia, R., Utomo, B., ... & Chen, K. H. (2023). The effect of virtual reality on cognitive, affective, and psychomotor outcomes in nursing staffs: systematic review and meta-analysis. *BMC nursing*, *22*(1), 170. https://doi.org/10.1186/s12912-023-01312-x
13. Esposito, C., Autorino, G., Iervolino, A., Vozzella, E. A., Cerulo, M., Esposito, G., ... & Escolino, M. (2022). Efficacy of a virtual reality program in pediatric surgery to reduce anxiety and distress symptoms in the preoperative phase: a prospective randomized clinical trial. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, *32*(2), 197-203. https://doi.org/10.1089/lap.2021.0566
14. Felemban, O. M., Alshamrani, R. M., Aljeddawi, D. H., & Bagher, S. M. (2021). Effect of virtual reality distraction on pain and anxiety during infiltration anesthesia in pediatric patients: a randomized clinical trial. *BMC Oral Health*, *21*(1), 321. https://doi.org/10.1186/s12903-021-01678-x
15. Ferguson, C., Davidson, P. M., Scott, P. J., Jackson, D., & Hickman, L. D. (2015). Augmented reality, virtual reality and gaming: an integral part of nursing. *Contemporary nurse*, *51*(1), 1-4. https://doi.org/10.1080/10376178.2015.1130360
16. Foronda, C. L., Fernandez-Burgos, M., Nadeau, C., Kelley, C. N., & Henry, M. N. (2020). Virtual simulation in nursing education: a systematic review spanning 1996 to 2018. *Simulation in Healthcare*, *15*(1), 46-54. *DOI:* 10.1097/SIH.0000000000000411
17. Gutiérrez-Puertas, V., Gutiérrez-Puertas, L., Aguilera-Manrique, G., Rodríguez-García, M. C., & Márquez-Hernández, V. V. (2021). Nursing students' perceptions of smartphone use in the clinical care and safety of hospitalised patients. *International Journal of Environmental Research and Public Health*, *18*(3), 1307. https://doi.org/10.3390/ijerph18031307
18. Hackenberger, A. (2023). Intensive care unit diaries: a nurse-led program. *Critical care nurse*, *43*(1), 20-30. https://doi.org/10.4037/ccn2023573
19. Indovina, P., Barone, D., Gallo, L., Chirico, A., De Pietro, G., & Giordano, A. (2018). Virtual reality as a distraction intervention to relieve pain and distress during medical procedures: a comprehensive literature review. *The Clinical journal of pain*, *34*(9), 858-877. *DOI:* 10.1097/AJP.0000000000000599
20. Kim, Y., Kim, H., & Kim, Y. O. (2017). Virtual reality and augmented reality in plastic surgery: a review. *Archives of plastic surgery*, *44*(03), 179-187. https://doi.org/10.5999/aps.2017.44.3.179
21. Lan, X., Tan, Z., Zhou, T., Huang, Z., Huang, Z., Wang, C., ... & Huang, Y. (2023). Use of virtual reality in burn rehabilitation: a systematic review and meta-analysis. *Archives of physical medicine and rehabilitation*, *104*(3), 502-513. https://doi.org/10.1016/j.apmr.2022.08.005
22. Laver, K. E., Lange, B., George, S., Deutsch, J. E., Saposnik, G., & Crotty, M. (2018). Virtual reality for stroke rehabilitation. *Stroke*, *49*(4), e160-e161. https://doi.org/10.1161/STROKEAHA.117.020275
23. Lee, S., Kim, Y., & Lee, B. H. (2016). Effect of virtual reality-based bilateral upper extremity training on upper extremity function after stroke: a randomized controlled clinical trial. *Occupational therapy international*, *23*(4), 357-368. https://doi.org/10.1002/oti.1437
24. Li, X., Luh, D. B., Xu, R. H., & An, Y. (2023). Considering the consequences of cybersickness in immersive virtual reality rehabilitation: a systematic review and meta-analysis. *Applied Sciences*, *13*(8), 5159. https://doi.org/10.3390/app13085159
25. Litwin, S. P., Nguyen, C., Hundert, A., Stuart, S., Liu, D., Maguire, B., ... & Stinson, J. (2021). Virtual reality to reduce procedural pain during IV insertion in the pediatric emergency department: a pilot randomized controlled trial. *The Clinical journal of pain*, *37*(2), 94-101. *DOI:* 10.1097/AJP.0000000000000894

26. Moyer, J. E. (2023). Virtual reality simulation applications in pre-licensure psychiatric nursing curricula: An integrative review. *Issues in Mental Health Nursing*, *44*(10), 984-1001. https://doi.org/10.1080/01612840.2023.2243330
27. Nault, K. A., & Thau, S. (2022). Professions, honesty, and income. *Current Opinion in Psychology*, *47*, 101403. https://doi.org/10.1016/j.copsyc.2022.101403
28. Navarro-Haro, M. V., López-del-Hoyo, Y., Campos, D., Linehan, M. M., Hoffman, H. G., García-Palacios, A., ... & García-Campayo, J. (2017). Meditation experts try Virtual Reality Mindfulness: A pilot study evaluation of the feasibility and acceptability of Virtual Reality to facilitate mindfulness practice in people attending a Mindfulness conference. *PloS one*, *12*(11), e0187777. https://doi.org/10.1371/journal.pone.0187777
29. Riches, S., Pisani, S., Bird, L., Rus-Calafell, M., Garety, P., & Valmaggia, L. (2021). Virtual reality-based assessment and treatment of social functioning impairments in psychosis: a systematic review. *International Review of Psychiatry*, *33*(3), 337-362. https://doi.org/10.1080/09540261.2021.1918648
30. Saab, M. M., Landers, M., Murphy, D., O'Mahony, B., Cooke, E., O'Driscoll, M., & Hegarty, J. (2022). Nursing students' views of using virtual reality in healthcare: A qualitative study. *Journal of Clinical Nursing*, *31*(9-10), 1228-1242. https://doi.org/10.1111/jocn.15978
31. Saposnik, G. (2016). Virtual reality in stroke rehabilitation. In *Ischemic stroke therapeutics: A comprehensive guide* (pp. 225-233). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-17750-2_22
32. Schroeder, A. H., Bogie, B. J., Rahman, T. T., Therond, A., Matheson, H., & Guimond, S. (2022). Feasibility and efficacy of virtual reality interventions to improve psychosocial functioning in psychosis: systematic review. *JMIR Mental Health*, *9*(2), e28502. https://doi.org/10.2196/28502
33. Shevchuk, O. M. (2023). Administrative and legal means of protecting citizens of Ukraine in public administration. *Publishing House "Baltija Publishing"*. https://doi.org/10.20956/halrev.v9i2.4396
34. Shevchuk, O., Bululukov, O., Lysodyed, O., Mamonova, V., & Matat, Y. (2021). Human right to virtual reality in the healthcare: legal issues and enforcement problems. *Juridical Tribune/Tribuna Juridica*, *11*.
35. Shin, J. H., Kim, M. Y., Lee, J. Y., Jeon, Y. J., Kim, S., Lee, S., ... & Choi, Y. (2016). Effects of virtual reality-based rehabilitation on distal upper extremity function and health-related quality of life: a single-blinded, randomized controlled trial. *Journal of neuroengineering and rehabilitation*, *13*(1), 17. https://doi.org/10.1186/s12984-016-0125-x
36. Shorey, S., & Ng, E. D. (2021). The use of virtual reality simulation among nursing students and registered nurses: A systematic review. *Nurse education today*, *98*, 104662. https://doi.org/10.1016/j.nedt.2020.104662
37. Sigmon, C. A. N., Park, S. Y., Bam, D., Rimel, S. E., & Boeldt, D. L. (2023). Feasibility and acceptability of virtual reality mindfulness in residents, fellows, and students at a university medical campus. *Mayo Clinic Proceedings: Digital Health*, *1*(4), 467-475. https://doi.org/10.1016/j.mcpdig.2023.07.006
38. Smith, K. L., Wang, Y., & Colloca, L. (2022). Impact of virtual reality technology on pain and anxiety in pediatric burn patients: a systematic review and meta-analysis. *Frontiers in virtual reality*, *2*, 751735. https://doi.org/10.3389/frvir.2021.751735
39. Son, H., Ross, A., Mendoza-Tirado, E., & Lee, L. J. (2022). Virtual reality in clinical practice and research: viewpoint on novel applications for nursing. *JMIR nursing*, *5*(1), e34036. https://doi.org/10.2196/34036
40. Yamato, T. P., Pompeu, J. E., Pompeu, S. M., & Hassett, L. (2016). Virtual reality for stroke rehabilitation. *Physical therapy*, *96*(10), 1508-1513. https://doi.org/10.2522/ptj.20150539