This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

Virtual Reality in Nursing Education: A Hospital Innovation Case Study

Mozhgan Sadr*

VKMB, Spitalgasse 23, 1090 Vienna, Austria.
E-mail: Mozhgan.sadr@vkmb.com

Fahad Al Rawi

VKMB, Spitalgasse 23, 1090 Vienna, Austria.
E-Mail: Fahad.AlRawi@vkmb.com

Sebastian Egger-Lampl

Mindconsole GmbH, Wielandgasse 56, 8010 Graz, Austria.
E-Mail: sebastian@mindconsole.net

Markus Karlseder

Mindconsole GmbH, Wielandgasse 56, 8010 Graz, Austria.
E-Mail: markus@mindconsole.net

* Corresponding author

Abstract: Extended Reality (XR) technologies, particularly Virtual Reality (VR), are increasingly explored as tools in healthcare education, yet their integration into clinical training remains inconsistent and often lacks user-centered design. This case study describes the development and implementation of a VR-based training environment for delirium in nursing education within a hospital setting and outlines future application areas.

The project followed a structured, theory-informed approach, including an analysis of VR, Augmented Reality (AR), and Mixed Reality (MR), and was further developed within the framework of an idea competition on XR applications in clinical practice. Delirium was selected as a high-impact use case. A participatory co-design approach based on the VIENNO model ensured continuous involvement of nurses and clinical experts.

The resulting VR training enables immersive, scenario-based learning and achieved strong user acceptance. Future applications include VR for second victim support, patient anxiety and pain reduction, and rehabilitation in physical medicine.

VR represents a promising tool for nursing education and beyond, provided it is implemented through clinically relevant and user-centered design.

Keywords: Virtual Reality; Nursing Education; Extended Reality (XR); clinical simulation; Delirium; Co-Design; Participatory Design; Healthcare Innovation; Immersive technologies; VIENNO; Digital Health Innovation.

This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

1 Introduction

In 2023, the authors began a structured theoretical engagement with Extended Reality (XR) technologies, exploring their potential to transform clinical education and practice within healthcare settings. XR technologies are understood as immersive digital environments that extend human perception and interaction by broadening reality, augmenting clinical capabilities and enabling the creation of context-rich learning spaces. During this phase, the authors systematically analyzed the strengths and limitations of Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), with particular attention to their underlying technological principles, relevant research domains, and established use cases in healthcare education and clinical training (Sadr et al., 2023).

This initial exploration formed the conceptual basis for a more focused innovation effort, which was subsequently advanced through participation in the idea competition "XR application in everyday clinical practice". Within this framework, the team identified and selected a high-impact yet under-addressed clinical niche: delirium[1]. This topic was chosen due to its high prevalence in acute care settings, its clinical complexity, and the frequent need for rapid, situation-aware decision-making in nursing practice.

Focusing on delirium in nursing education was further motivated by the challenges it poses for timely recognition and appropriate clinical response. Its multifactorial presentation and dynamic course make it particularly suitable for immersive, scenario-based learning approaches that support experiential understanding and clinical reasoning under realistic conditions.

Importantly, strong customer buy-in had already been established prior to the development phase through the collaborative application of the VIENNO model. VIENNO (Vienna Innovation Model) is a collaborative innovation ecosystem that connects research, industry, and society to drive sustainable, real-world solutions. This model was developed by University Hospital Vienna, VKMB, and Carinthia University of Applied Sciences (Granig and Sadr, 2017).

In this participatory framework, nurses as experts were actively involved not only as end-users but as co-designers of the innovation process. Their contributions ensured that practical clinical needs, educational requirements, and contextual constraints were integrated from the outset, enabling early and sustained alignment between user expectations and technological development.

This co-creative foundation enabled the design and implementation of a Virtual Reality (VR)-based training environment within the hospital context. The resulting approach reflects a user-centered innovation process that combines immersive technology with clinical expertise to enhance nursing education in the management of delirium.

2 Background: Virtual Reality in Nursing and Medical Education

Virtual Reality (VR) has emerged as a rapidly evolving educational technology within healthcare, offering immersive, interactive, and simulation-based learning environments. VR is commonly defined as a computer-generated, three-dimensional

[1] Delirium is a concurrent disturbance of consciousness and cognition with impaired attention, typically with acute onset and fluctuating course (Beal and Neufeld, 2025).

environment that enables users to interact with simulated clinical scenarios in a perceived sense of presence, often supported by head-mounted displays and sensory interfaces. This immersive capability allows learners to practice clinical skills and decision-making in a safe, controlled, and repeatable environment without risk to patients (Liu et al., 2023).

In nursing and medical education, VR is increasingly used to address limitations of traditional clinical training environments, which are often constrained by limited case exposure, time restrictions, and patient safety considerations. Conventional simulation methods, such as mannequin-based training, can only partially reproduce clinical complexity and variability. VR complements these approaches by enabling standardized exposure to diverse and rare clinical scenarios that learners may not otherwise encounter during clinical placements (Sung et al., 2024).

A growing body of evidence indicates that VR can enhance multiple domains of learning in healthcare education, including theoretical knowledge acquisition, procedural skills, clinical reasoning, and learner satisfaction. Systematic reviews and meta-analyses in nursing education demonstrate that VR-based training is generally more effective than traditional teaching methods in improving knowledge and skill performance, while also increasing learner engagement and confidence in clinical practice (Liu et al., 2023). More recent evidence further suggests that immersive VR can significantly improve clinical skills and problem-solving abilities, particularly when integrated into structured educational programs aligned with learning objectives (Jing-Yi et al., 2025).

Beyond cognitive and psychomotor outcomes, VR supports experiential learning by enabling learners to actively engage in realistic clinical scenarios. This aligns with constructivist learning theories, which emphasize learning through experience, reflection, and contextual application. In VR environments, learners can repeat procedures, receive immediate feedback, and safely explore consequences of clinical decisions, thereby bridging the gap between theoretical knowledge and clinical practice.

Despite these advantages, the integration of VR into routine nursing and medical curricula remains heterogeneous. Key barriers include variability in technological maturity, and the absence of standardized pedagogical frameworks for VR design and evaluation. Additionally, some studies highlight variability in learning outcomes depending on the level of immersion and the alignment of VR scenarios with curricular goals, indicating that effectiveness is strongly dependent on instructional design quality rather than technology alone (Jing-Yi et al., 2025).

Another critical challenge is the need for stronger alignment between VR development and clinical end-user requirements. Evidence suggests that educational effectiveness improves when healthcare professionals are actively involved in the design and validation of VR learning environments, ensuring authenticity, clinical relevance, and pedagogical value. However, many existing VR applications are still developed in technology-driven rather than practice-driven contexts, creating a gap between available solutions and real-world educational needs.

Within this context, nursing education represents a particularly relevant domain for VR innovation. Nursing practice requires the integration of theoretical knowledge, clinical reasoning, and rapid situational decision-making under time pressure. These demands make it especially suitable for immersive simulation-based learning approaches. This is particularly evident in complex clinical conditions such as delirium, where early recognition and appropriate intervention are critical but difficult to fully experience in traditional training environments.

This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

3 Project Context Setting

The following section outlines the organizational context in which the project was embedded.

At the University Hospital Vienna, a joint innovation management system is operated by the hospital and VKMB, technical operations manager of the University Hospital Vienna. Within this framework, both organizations collaborate closely to identify, plan and implement innovation projects.

The innovation project originated on the joint ideas platform, where the idea of using “VR glasses” was submitted as part of a collaborative idea competition. Following this submission, the innovation team initiated a comprehensive exploration of extended reality technology as an emerging trend. As part of this exploration, an academic article entitled “How virtual seeing and feeling is transforming healthcare” was published for ISPIM, in which the authors examined, among other aspects, the application of XR technology in the healthcare sector. In parallel, several discussions were conducted with representatives from various professional areas within the hospital.

In particular, representatives from nursing and professional development realized the potential relevance of XR technology for education and training purposes and expressed strong interest in its integration into training programs. To further explore this potential, joint workshops were organized in which participants were introduced to XR technology and given the opportunity to test and experience VR headsets themselves. Within these collaborative creativity workshops, delirium emerged as a key topic for training. It was recognized that VR-based could offer significant added value in the education of healthcare staff on delirium. As a result, a decision was made to explicitly address the topic of delirium within the VR-based training concept in order to provide an immersive learning experience.

In subsequent workshops, the concept for a delirium-focused training program was further elaborated. This process culminated in the official launch of the DelirXR App, which was designed to support the training and continuing education of nursing staff in the field of delirium. Following this conceptual phase, the organizational and governance structure of the project was formally defined.

Project management responsibility was assigned to VKMB. The interdisciplinary project team included several representatives from the Nursing Directorate of the University Hospital Vienna, as well as individuals from nursing practice and competency development. Mindconsole GmbH served as the technology partner responsible for technical implementation. In addition, the project was accompanied by a representative from the innovation division of the Vienna Healthcare Group.

The project was officially initiated on November 22, 2024, with a formal kick-off workshop. In the subsequent phase, the solution was specified in greater detail, and a requirements specification was developed. One of the requirements was offline functionality with local installation, aimed at limiting dependency on existing infrastructure. A project schedule was created to provide a transparent timeline for all stakeholders.

The project was structured into a core project and an extension project. The core project focused on delirium prevention, whereas the extension project addressed delirium management. Both components followed a structured development process comprising alpha, beta, and release candidate phases. This iterative approach enabled multiple

feedback loops, allowing content to be thoroughly tested and systematically refined. Continuous involvement of future users supported a user-centered innovation process.

Several stakeholder groups were involved throughout the project. The primary stakeholders were nursing experts, who participated actively as members of the project team. Numerous review cycles were conducted to ensure that the app was tailored to the needs of this target group. Throughout the project, these experts constituted the most important sources of feedback.

The second key stakeholder group consisted of the technology partners. Testing phases were jointly organized, and the systematically collected test results were provided to the developers. During these meetings, it was ensured that feedback was consistently incorporated into subsequent development iterations.

The third stakeholder group was the steering committee, which comprised representatives from different directorates of the University Hospital Vienna. Regular steering committee meetings were held, during which the project's progress was discussed. The steering committee was actively involved throughout all project phases and continuously informed about key developments.

4 Design and Implementation of the VR Training Program

On January 27, 2025, a so-called walkable presentation took place, during which participants could virtually tour the patient room and test initial procedures within the room. In this workshop, using a design thinking approach, the group discussed which specific scenarios would best support effective training. Module 1 is intended to include a tutorial. In this tutorial, participants are able to enter the patient room and learn several procedures using the VR headset and controllers. The goal is to become familiar with the VR environment and the controllers so that users feel comfortable and are able to use the application safely. Especially when using a VR headset and the DelirXR app for the first time, it is particularly important to initially familiarize oneself with the system. The tutorial is guided, allowing users to learn all essential topics in a very short period of time.

It was determined that it would be beneficial to design one training module from the perspective of a nurse and one from the perspective of a patient. Module 2 is intended to present the patient's perspective. This means that users experience what a patient with delirium perceives. In Module 3, the nursing perspective is represented. In this module, the nurse enters a hospital patient room and performs several key nursing procedures for the patient with delirum. A total of five different scenarios are planned for this module. Scenario 1 addresses delirium prevention, while scenarios 2 through 5 focus on delirium management. Two scenarios address hyperactive delirium and two address hypoactive delirium. Originally, only delirium prevention was planned for the training program. However, the workshops revealed that delirium management is equally essential to ensure effective and successful training.

The narratives for the five scenarios are based on cases described in a book (Hadi, 2023). The author is a nurse and delirium expert and was also actively involved as a member of the project team. Five real-life cases were selected from this publication. At the beginning of each scenario, a case vignette as well as an initial task are presented, in which users are required to select the correct answers. At the end of each scenario,

additional assessment questions based on Nu-DESC -screening scale to identify delirium-related to the case are provided. The correct answers are displayed at the end, allowing users to consolidate and deepen their knowledge effectively.

For the training, it is important that the virtual environment felt as realistic as possible in order to maximize the immersive benefits of the training. For this reason, the virtual patient room corresponds exactly to the real patient room. To achieve this, a 3D scan was conducted. The positions of all furniture and equipment were replicated. In addition, a photograph capturing the view from the patient room was taken. As a result, looking out of the virtual window reveals the same city view as in the real patient room.

Throughout the project, the selection of VR headset hardware was also addressed. Ultimately, five Meta Quest 3 headsets were ordered and used. In addition, battery-equipped head straps were purchased. These enhance comfort by improving headset stability, particularly during long training sessions. Another major advantage is the integrated spare battery, which allows an additional battery to be quickly connected when the main battery runs low. Hygiene considerations are also particularly important in a hospital environment. Since the headsets are used by multiple individuals, a silicone face insert is required. Therefore, additional disinfectable silicone inserts were ordered for the headsets. Spare batteries are also included, as the controllers are battery-operated and required replacement after extended use.

Within the context of nursing and professional development, two types of training sessions are planned. First, group training sessions using a projector will be offered. During these sessions, the DelirXR app will be presented and demonstrated via the projector. The content and scenarios are reviewed, and the content will also be discussed critically within the group. Second, participants have the option to borrow the VR headsets. Participants can borrow the VR headsets for a defined period of time to independently complete and practice the individual scenarios.

Collaboration played a central role throughout the project and consisted of a mix of in-person meetings and workshops, as well as digital collaboration formats. In particular, digital collaboration played an important role. Individual scenarios and user stories were documented on a Miro board, enabling all project participants to gain a clear and shared understanding of the content. During the various project phases, test versions of the DelirXR app were actively tested by multiple participants. Feedback was systematically documented. To ensure transparency, feedback points were digitally recorded directly alongside the corresponding videos. Videos were recorded for each scenario, to which digital comments could be added. This approach efficient documentation and facilitated structured discussion of feedback during review meetings. During subsequent testing phases, it was clearly visible which feedback points had already been implemented and which remained open.

The following section presents the initial outcomes and user feedback from the early application of the VR training program.

5 Results

At the end of the project, a wrap-up meeting was held. During this meeting, the project was officially concluded. The VR headsets were officially handed over to representatives from the nursing and professional development teams. At this meeting, the completeness and functionality of the final release candidate version were officially confirmed.

Overall, the DelirXR innovation project was very successful. Collaboration within the project team worked very well, as confirmed by all participants. During the final feedback session, the project was reviewed once more, and the team jointly reflected on potential next steps. For example, the Meta Business version was discussed and considered as a future option to enable improved management of the VR headsets. With this version, it would be possible, for instance, to monitor the remaining battery levels of the Meta headsets. In the future this solution could provide additional support for remote maintenance and device management.

The group also discussed how to handle future ideas that may arise over time. It was agreed to establish an “idea repository” in which ideas that emerge during the day-to-day use of the VR headsets can be systematically collected. It was acknowledged that once regular use begins, additional ideas for further improvement are likely to arise.

Promoting the project was also identified as an important aspect. This includes increasing awareness of the project, for example through the Austrian Delir Network, and presenting it to individuals and institutions with a potential interest in its application.

Innovation marketing was therefore considered as a key component. At the end of the project, the initiative was featured on social media. Press releases were also issued, for example by the City of Vienna, and coverage appeared in additional media outlets. Communication activities included social media channels, where the training and continuing education of nursing staff and the nursing department spoke positively about the solution. In addition, a news article was published on the University Hospital Vienna intranet.

Ultimately, the overarching goal is to make this project accessible to as many people as possible so that, in turn, as many patients can benefit from it.

A few months after the app was introduced and implemented in practice, feedback was actively sought from the nursing and professional development teams regarding the use of DelirXR app and user responses. Feedback on current usage was very positive. VR and delirium training sessions have already begun and are gradually becoming part of routine practice. As a result, the VR headsets are increasingly in use. The training program has been well received, and the VR headsets are regularly borrowed.

Several teams from different hospital departments have also borrowed the VR headsets and are using them for training purpose. For example, the neurosurgery team has used the VR headsets. Almost daily, inquiries regarding VR and delirium training are received via email, with individuals expressing interest in borrowing the VR equipment. Overall, a high level of positive feedback has been observed.

Initially, it was assumed that the program would be more suitable for younger staff members. In practice, however, it became clear that older colleagues also rate the VR and delirium training very highly. They emphasize that the training raises awareness and

report that the nursing process presented in the application is easy to follow and that the content is generally well explained.

Calibrating the VR headsets (height adjustment) can sometimes present a minor challenge during the initial setup phase. Overall, the training sessions are considered very informative.

An application for an Austrian innovation award was also submitted. Other Vienna Healthcare Group clinics have expressed interest in the solution. Initial discussions have already taken place, and some representatives have tested the app.

6 Future Application of VR (Planned Developments)

Building on the insights gained from the development and implementation of the VR-based delirium training environment, several future application areas have been identified to further leverage the potential of immersive technologies within clinical practice. These planned developments extend beyond education into therapeutic and supportive domains, reflecting a broader vision of VR as an integrated tool in patient care and healthcare professional support.

A first area of application focuses on psychological support for healthcare professionals, particularly in addressing the phenomenon of the "second victim." The term, introduced by Albert W. Wu, describes healthcare workers who experience emotional distress following adverse clinical events. VR-based interventions offer the potential to create safe, immersive environments for reflection, coping, and resilience training. Through guided scenarios and structured debriefing simulations, healthcare professionals could engage with emotionally challenging situations in a controlled setting, supporting both individual coping strategies and organizational learning cultures.

A second application area targets the psychological support of patients. Many patients experience anxiety, uncertainty, or distress when facing diagnostic procedures, invasive treatments, or acute pain. VR can be used as a tool for distraction, relaxation, and emotional regulation, for example by immersing patients in calming virtual environments or guided experiences during procedures. In addition, VR-based preparatory simulations could help patients better understand upcoming interventions, thereby reducing fear and improving perceived control. Such approaches align with existing evidence on the use of VR in pain management and anxiety reduction, where immersive distraction has been shown to positively influence patient experience and outcomes.

The third application area lies in physical medicine, particularly in rehabilitation and mobilization. VR has already demonstrated potential in supporting motor recovery through interactive and engaging training environments. One promising approach is its use in mirror therapy, a technique traditionally applied in neurorehabilitation for conditions such as stroke or phantom limb pain. By creating virtual representations of movement, VR can enhance the illusion of symmetrical motor function and provide real-time feedback, potentially improving neuroplasticity and patient motivation. Furthermore, VR-based mobilization programs can gamify rehabilitation exercises, increasing adherence and enabling individualized progression within both inpatient and outpatient settings.

Across all three use cases, a common principle remains central: the integration of end-user perspectives through participatory design approaches. Building on the experience with the VIENNO model (Granig and Sadr, 2017), future developments will

continue to involve healthcare professionals and patients as active contributors to the design process. This ensures that technological solutions are not only innovative but also clinically relevant, usable, and aligned with real-world needs.

Taken together, these planned applications illustrate the potential of VR to evolve from a primarily educational tool into a multifunctional component of patient care and healthcare system support. They highlight a shift toward more holistic, user-centered applications of immersive technologies that address both clinical outcomes and human experiences within healthcare environments.

7 Conclusion

This case study demonstrates how Virtual Reality (VR) can be systematically integrated into nursing education through a structured, theory-informed, and user-centered innovation process. Beginning with a comprehensive exploration of Extended Reality (XR) technologies, the project evolved from conceptual analysis to practical implementation within a clinical context. The deliberate focus on delirium as a complex and under-addressed clinical condition highlights the potential of immersive learning environments to support the development of clinical reasoning and situation awareness in nursing practice.

A key success factor of the project was the early and continuous involvement of end-users through the application of the VIENNO model. By actively engaging nurses and clinical experts as co-designers, the project ensured alignment between technological possibilities and real-world clinical needs. This participatory approach not only facilitated strong acceptance and relevance but also contributed to the development of a training solution grounded in authentic clinical practice.

The findings underline that the effectiveness of VR in healthcare education depends not solely on technological sophistication, but on its integration into pedagogically sound and contextually relevant learning designs. VR-based training can complement existing educational methods by enabling experiential, repeatable, and safe learning opportunities, particularly for complex and high-risk clinical scenarios.

Looking beyond the initial implementation, the identified future application areas demonstrate the broader potential of VR within healthcare systems. From supporting healthcare professionals in coping with emotional stress to enhancing patient-centered care and enabling innovative rehabilitation approaches, VR may contribute to a more holistic and responsive healthcare environment.

However, further research is needed to evaluate long-term educational outcomes, cost-effectiveness, and scalability of VR applications in clinical settings. In addition, the development of standardized frameworks for design, implementation, and evaluation remains a critical requirement for sustainable integration.

In conclusion, this study highlights VR as a promising and versatile tool in nursing education and beyond, provided that its development is guided by clinical relevance, pedagogical rigor, and active stakeholder involvement.

References and Notes

Beal, M. and Neufeld, K. (2025) *Delirium*. Johns Hopkins Medicine Web site. https://www.hopkinsguides.com/hopkins/view/Johns_Hopkins_Psychiatry_Guide/787106/all/Delirium, accessed: April 2026.

Granig, P. and Sadr, M. (2017) *VIENNO – Vienna Innovation Model: A Collaborative Approach*. In: *Proceedings of the XXVIII ISPIM Innovation Conference*.

Hadi, R. (2023) *Delir: Berichte von Betroffenen*. Wien: Facultas.

Hsieh, J.-Y., Lin, P.-C., Sun, W.-N., Lin, T.-R., Kuo, C.-C. and Hsu, H.-T. (2025) *Effectiveness of immersive virtual reality in nursing education for nursing students and nursing staff: a systematic review and meta-analysis*. *Nurse Education Today*, 151, 106725. https://doi.org/10.1016/j.nedt.2025.106725

Liu, K., Zhang, W., Li, W. *et al.* (2023) *Effectiveness of virtual reality in nursing education: a systematic review and meta-analysis*. *BMC Medical Education*, 23, 710. https://doi.org/10.1186/s12909-023-04662-x#

Sadr, M., Al Rawi, F., Hassanein, A. and Wagner, M. (2023) *How virtual seeing and feeling is transforming healthcare*. ISBN 978-952-65069-3-7.

Sung, H., Kim, M., Park, J., Shin, N. and Han, Y. (2024) *Effectiveness of Virtual Reality in Healthcare Education: Systematic Review and Meta-Analysis*. *Sustainability*, 16(19), 8520. https://doi.org/10.3390/su16198520