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REVIEW ARTICLE

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VIRTUAL REALITY FOR THE PREVENTION AND REDUCTION OF DELIRIUM IN CRITICALLY ILL PATIENTS: A SCOPING REVIEW

***Refonda Rias Anggiri[1], Baharudin Priwintoko[2,3], Siwi Hastuti[4]**
[1]School of Nursing, STIKES Mamba'ul 'Ulum Surakarta, Surakarta, Indonesia
[2]Department of Manufacturing Engineering Technology, Akademi Inovasi Indonesia, Indonesia
[3]Department of Mechanical Engineering, Faculty of Engineering, Universitas Diponegoro, Indonesia
[4]Pharmacy Study Program, Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, Indonesia
*Corresponding Author: Refonda Rias Anggiri (refondarias@stikesmus.ac.id)

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ABSTRACT

Background: Delirium is a common complication among critically ill patients in Intensive Care Units (ICUs), associated with higher mortality, longer ICU stay, and long-term cognitive decline. Pharmacological management remains limited, underscoring the need for innovative non-pharmacological strategies. Virtual Reality (VR) has emerged as a promising intervention, offering immersive sensory stimulation, relaxation, and family engagement that may help prevent delirium.
Methods: A scoping review was conducted across databases. PubMed, Scopus, and ProQuest databases were searched in July 2024 using terms related to "virtual reality," "intensive care," and "delirium." Eligible studies included adult ICU patients and were published between 2019 and 2024, and reported outcomes on delirium incidence, duration, severity, or related factors. Review articles and inaccessible full texts were excluded.
Results: Five studies met the inclusion criteria. Two were pilot trials, one was a pilot randomized controlled trial, and two were prospective cohort studies. VR interventions included immersive meditation, neurocognitive stimulation, and family visitation systems. Across studies, VR was found to be safe, feasible, and well accepted by patients. Studies demonstrated a significant reduction in delirium incidence with VR family visits. At the same time, smaller trials showed improvements in anxiety, cognitive engagement, and patient satisfaction, but no consistent reductions in delirium outcomes.
Conclusion: VR appears to be a safe and innovative adjunct for critically ill patients, with potential benefits in patient experience and anxiety reduction. Future research requires larger multicenter randomized trials with standardized protocols.

Keywords: Critically Ill Patients; Delirium; Intensive Care Unit; Virtual Reality

INTRODUCTION

Delirium is a prevalent neuropsychiatric complication in critically ill patients in the Intensive Care Unit (ICU), with a reported prevalence of 30–80% in adult patients, particularly those receiving mechanical ventilation (Kotfis et al., 2022). This condition has been associated with increased mortality, length of ICU stay, duration of mechanical ventilation, and long-term cognitive impairment (Girard et al., 2018; Kotfis et al., 2022). Prevention and management of delirium have included pharmacological and non-pharmacological approaches (Park & Lee, 2019). However, pharmacological therapy has proven to have limited effectiveness and may even increase the risk of side effects (Devlin et al., 2018). Consequently, non-pharmacological interventions are gaining traction, encompassing strategies within the ABCDEF bundle (Assessment, Breathing trials, Choice of sedation, Delirium monitoring, Early mobility, Family engagement) (Devlin et al., 2018). However, the efficacy of delirium prevention strategies remains inconsistent, underscoring the need for novel and innovative approaches.

The advent of Virtual Reality (VR) technology has emerged as a promising intervention in the ICU, owing to its capacity to provide immersive multisensory stimulation. VR has been demonstrated to facilitate relaxation, provide natural environments, and facilitate virtual family visits (Kanschik et al., 2023; Locke et al., 2024). These experiences are expected to reduce anxiety, improve sleep quality, provide cognitive reorientation, and increase patient social interaction. A multitude of preliminary studies have indicated that the utilization of VR in the ICU is both safe and well-tolerated by patients. Furthermore,

these studies suggest that VR holds considerable potential in facilitating psychological recovery in this setting (Jawed et al., 2020; Ong et al., 2020; Suvajdzic et al., 2019). A more extensive cohort study revealed that the implementation of family visit-based VR significantly reduced the incidence of delirium in comparison to the control group (He et al., 2022).

However, the extant evidence is still limited to small-scale studies with heterogeneous designs and often focuses on subjective outcomes such as anxiety or patient experience, rather than the incidence or duration of delirium (Navarra-Ventura, Gomà, et al., 2021). The heterogeneity of VR types (immersive vs. non-immersive), content, duration, and patient characteristics selected also makes it difficult to generalize the results. A multitude of recent systematic reviews underscore the promise of VR in the ICU. However, these reviews also highlight the paucity of high-quality clinical evidence for delirium, emphasizing the necessity for large-sample, multicenter randomized clinical trials (Hill et al., 2021; Kanschik et al., 2023). Considering the background, the objective of this article is to critically evaluate the most recent evidence concerning the utilization of VR technology in critically ill adult patients in the ICU, with a particular focus on its application in the prevention and reduction of delirium.

METHOD

The research method employed a scoping review approach guided by Arksey and O'Malley (Arksey & O'Malley, 2005). The search engine used the following search terms: ("virtual reality" OR "immersive virtual reality" OR "360 video" OR "head-mounted display" OR "VR meditation" OR "virtual reality exposure") AND ("intensive care" OR 'ICU' OR "critical care" OR "critically ill") AND (delirium OR "acute confusional state" OR "acute brain dysfunction"). A comprehensive literature search was conducted in July 2024 using the Scopus, PubMed, and ProQuest databases.

The PCC (Population, Concept, and Context) framework was employed in the literature search and screening method Table 1.

Table 1. PCC Framework

Population	Adult patients (aged 18 years and over) who are currently admitted to the ICU
Concept	The utilization of VR on ICU patients with delirium
Context	ICU

The search was limited to articles from international journals published between 2019 and 2024. The exclusion criteria encompassed review articles, including systematic and literature reviews, as well as articles that did not provide full-text access. The article search and selection process is illustrated in the PRISMA-ScR checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) (Tricco et al., 2018), flow in Figure 1. Critical appraisals of the included studies were conducted using the Joanna Briggs Institute (JBI) (Porritt, K., Gomersall, J., & Lockwood, C., 2014), shown in Table 2.

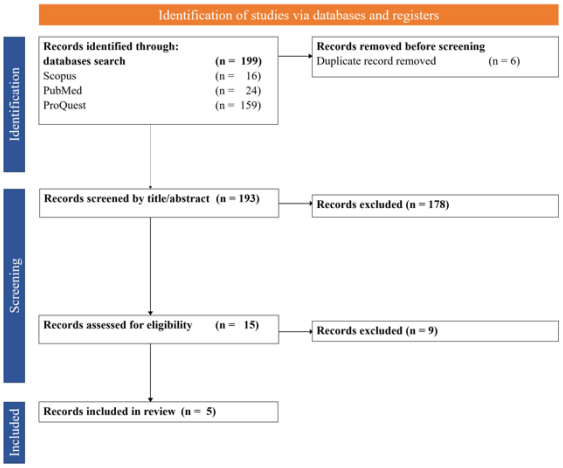

Figure 1. PRISMA-ScR Flow

RESULT

A total of five studies involving critically ill adult patients treated in ICUs were included in this review. Of these studies, two were pilot trials, one was a pilot randomized controlled trial (RCT), and two were prospective cohort studies. The interventions utilized in the study encompassed a range of approaches, including immersive VR meditation employing head-mounted displays, non-immersive VR-based neurocognitive stimulation, and 5G-supported VR family visit systems. The results of this study are presented in Table 2.

The study conducted by (He et al., 2022) In China, there was a substantial decrease in the incidence of delirium: 1.41% in the VR visit group (n=71) compared to 10% in the no-visit group (n=70) (p=0.027). In contrast, a pilot randomized controlled trial RCT utilized an early VR-based neurocognitive stimulation platform (n = 34 vs. n = 38) and found no significant difference in delirium incidence between the intervention and control groups, although improvements in cognitive engagement were reported.

Table 2. Summary of Article Review

Author, Year	Research Design	Location	Types of Virtual Reality	JBI	Findings
He et al. (2022)	Prospective cohort study	West China Hospital, Sichuan University, China	5G+VR system for virtual family visits, immersive 360° video	5/11	A 5G-enabled VR family visitation method during COVID-19 restrictions was linked to significant decreases in anxiety and depression scores and a lower observed rate of delirium compared to no visitation, indicating the potential usefulness of remote VR visits to support psychological well-being and outcomes related to delirium.
Jawed et al. (2021)	Pilot feasibility study	Indiana University, USA	Samsung Gear VR, Dream Beach immersive VR, 15-min sessions	5/7	VR delivery in the ICU was described as safe, feasible, and acceptable to both patients and healthcare providers. Most participants reported positive experiences with minimal side effects, and some patients experienced anxiety relief, although analgesic effects were not consistently noted.
Navarra-Ventura G. et al. (2021)	Pilot RCT	Parc Taulí University Hospital, Spain	ENRIC platform, non-immersive VR-based neurocognitive stimulation	6/13	This pilot randomized clinical trial indicated that non-immersive VR-based early neurocognitive stimulation might improve working memory performance at follow-up. Emotional outcomes (e.g., anxiety/depression) showed inconsistent or trend-level differences, suggesting potential benefits but needing confirmation in larger studies.
Ong et al. (2020)	Single arm prospective Pre and post-test design study	University of Florida, Academic Hospital, USA	Immersive VR (Google Daydream VR)	5/7	Daily meditative VR for non-intubated ICU patients was associated with reductions in anxiety and depressive symptoms and a favorable patient experience. However, the study found no clear improvement in physiological parameters, pain intensity, or sleep outcomes, supporting feasibility rather than definitive efficacy.
Suvajdzic M. et al. (2019)	Pilot feasibility study	University of Florida, USA	Immersive VR (Google Daydream, RelaxVR, Bait!, Spotlight Stories)	4/7	The DREAMS ICU VR system was reported as feasible to deploy in the ICU setting. Early outcome data suggested limited measurable clinical effects, but the intervention was highly acceptable to patients and operationally implementable; the paper emphasizes practical implementation lessons for VR use targeting delirium prevention.

Study by (Jawed et al., 2021) and a pilot study by (Suvajdzic et al., 2019) confirmed that VR interventions are safe, well-tolerated, and associated with high patient acceptance rates. However, these studies lacked sufficient statistical power to detect significant changes in delirium outcomes (Suvajdzic et al., 2019). In these studies, delirium was primarily assessed using the CAM-ICU tool, and immersive VR sessions typically lasted 15–20 minutes. Despite the heterogeneity in study designs and VR modalities, the existing body of evidence indicates that VR-based interventions may potentially reduce the incidence or severity of delirium, particularly when utilized during family visits and psychological support sessions. However, the efficacy of these interventions remains to be substantiated through rigorous RCTs.

DISCUSSION

This review identifies five studies exploring the use of VR technology in critically ill adult patients in ICU. Many of the studies were pilot and feasibility studies with small samples, which consistently reported that VR was a safe intervention that was well accepted by patients. For instance, (Suvajdzic et al., 2019) reported that Google Daydream-based VR could be implemented without significant adverse effects; however, its impact on the incidence of delirium was not yet substantial. Concurrent findings were reported by (Jawed et al., 2020, 2021), who found that the use of Samsung Gear VR with natural beach content reduced anxiety and was well accepted by patients. However, a significant reduction in delirium as measured by CAM-ICU was not shown. (Ong et al., 2020) also supported the feasibility of VR interventions by involving more patients, although about one-third of the patients still experienced delirium during their ICU care. In contrast to these studies, a larger prospective cohort study by (He et al., 2022) found that the use of a 5G+VR system for virtual family visits significantly reduced the incidence of delirium (1.41% vs. 10%). Concurrently, (Navarra-Ventura, Gomà, et al., 2021) reported no significant difference in the incidence of delirium in a small-scale randomized trial using the ENRIC platform, although there was a positive trend in cognitive outcomes.

These findings are consistent with the broader literature on the use of VR in the ICU. A recent systematic review by (Kanschik et al., 2023) corroborates the notion that virtual reality (VR) and augmented reality (AR) hold considerable promise as interventions in intensive care settings. These interventions appear to enhance patient experience, alleviate stress, and promote cognitive stimulation. However, the extant evidence on the outcomes of delirium remains inconclusive. In a seminal study, (Locke et al., 2024) demonstrated the safety and acceptance of VR in a medical ICU through an immersive VR approach. However, the impact on primary clinical outcomes requires further elucidation through expanded clinical trials. Furthermore, the most recent RCT protocol (Kotfis et al., 2022) expressly conceptualizes sensory stimulation-based VR as a delirium prevention intervention, with delirium-free days designated as the primary outcome, thereby signifying an escalating research interest in this domain.

Several potential mechanisms may elucidate the capacity of VR to influence delirium risk. Firstly, the use of VR has been demonstrated to provide reorientation cues that assist patients in maintaining an understanding of their temporal and spatial orientation. This, in turn, has been shown to reduce the risk of disorientation, a factor that has been identified as a contributing element to the development of delirium (Navarra-Ventura, Gomà, et al., 2021). Secondly, VR experiences with nature or relaxation content have been shown to reduce anxiety and stress, thereby decreasing the necessity for excessive sedation, a well-known risk factor for delirium (Jawed et al., 2021). Thirdly, VR-based neurocognitive platforms such as ENRIC provide structured cognitive stimulation that has the potential to enhance attention and memory function (Navarra-Ventura, Gomà, et al., 2021). Fourthly, the potential of VR to enhance social connections through virtual family visits has been demonstrated to reduce patient isolation during the pandemic (He et al., 2022). While these mechanisms are plausible, further research is necessary to substantiate their direct causal relationship with delirium prevention. This relationship should be evaluated with physiological biomarkers or other objective measurements.

A salient finding from these studies is the heterogeneity of VR interventions. The devices employed in these studies ranged from immersive headsets, such as the Google Daydream and the Samsung Gear VR, to non-immersive platforms like the ENRIC. The duration and frequency of the sessions also varied across studies (Jawed et al., 2020; Navarra-Ventura, Gomà, et al., 2021; Suvajdzic et al., 2019). The objectives of the interventions also differed, ranging from relaxation and cognitive stimulation to family visits. Consequently, the impact of delirium exhibited inconsistent outcomes. As (Kanschik et al., 2023) As noted, this variation in intervention design makes it difficult to generalize the results and hinders the conduct of a robust meta-analysis.

The quality of extant evidence remains deficient. Many studies are of the feasibility variety, which carries an elevated risk of selection bias. This is because these studies only include patients who are sufficiently stable and able to participate (Jawed et al., 2020; Suvajdzic et al., 2019).

Furthermore, the limited sample sizes inherent to these studies impede the capacity to discern moderate effects on delirium. The frequency with which delirium outcomes are measured varies, although the CAM-ICU (He et al., 2022; Navarra-Ventura, Albacar, et al., 2021) is a common tool employed by most researchers. The potential for publication bias must be considered, given that studies reporting positive patient experiences are more likely to be published than studies reporting neutral or negative results.

Overall, the prevailing sentiment regarding VR is that it is both safe and acceptable. The reported side effects are generally mild and transient, including symptoms such as nausea, dizziness, and short-term disorientation (Jawed et al., 2021; Ong et al., 2020). To date, there have been no reports of serious adverse events associated with VR in the ICU. Nevertheless, safety protocols persist in their significance, encompassing the judicious selection of patients, the provision of continuous supervision during utilization, and meticulous device disinfection procedures (Cicek & Akyol, 2022; Hill et al., 2021; Kanschik et al., 2023).

According to the extant data, VR has the potential to serve as a complementary non-pharmacological strategy to prevent or reduce delirium, particularly in stable and cooperative ICU patients. Nevertheless, the efficacy of VR in replacing established delirium prevention strategies, such as the ABCDEF bundle, sleep hygiene, early mobilization, and minimization of benzodiazepine use, remains to be substantiated (Kotfis et al., 2022, 2024). The clinical implementation of VR should commence with limited trials in units that possess adequate resources, while adhering to safety protocols and ensuring staff training.

CONCLUSION

Delirium continues to be a substantial clinical problem in critically ill adults, contributing to increased mortality, prolonged ICU stay, and long-term cognitive impairment. The present review indicates that virtual reality is a safe and well-tolerated intervention in the ICU, with potential benefits in reducing anxiety, enhancing patient orientation, and improving the overall ICU experience. However, the current evidence remains limited, as most studies are small-scale feasibility trials with inconsistent findings regarding their impact on delirium prevention.

RECOMMENDATION

Virtual reality should be considered as a complementary, non-pharmacological approach within established delirium prevention strategies rather than as a stand-alone intervention. Its utilization is most effectively directed toward stable and cooperative patients, preferably through pilot programs to evaluate feasibility and safety within each ICU setting. Future research should prioritize large, multicenter randomized controlled trials with standardized intervention protocols, explore underlying mechanisms, examine subgroup effects, and assess cost-effectiveness and long-term patient outcomes. Until stronger evidence emerges, virtual reality should be regarded as an innovative adjunctive strategy for delirium prevention in critical care.

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