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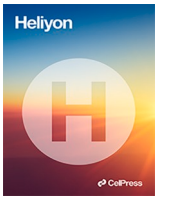

Review article

The impact of virtual reality on the psychological well-being of hospitalised patients: A critical review

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ABSTRACT

Background and objectives: Improving hospitalised patients' psychological well-being (PWB) is relevant to their recovery and overall quality of life. Virtual Reality (VR) holds the potential to emerge as a novel tool for increasing the PWB of hospitalised patients. This study critically reviewed existing research concerning the use and impact of VR on the PWB of hospitalised patients with serious illnesses. The primary aim of this study was to evaluate the efficacy and practical applicability of VR in enhancing the PWB for hospitalised patients dealing with serious illnesses.

Methodology: In the initial search, the authors identified 106 sources that provided valuable insights into the broader field of VR, PWB, and the influence of VR on the psychological functioning of hospitalised patients. However, only eight articles were selected for the critical review, following the SALSA method. The SALSA method comprises the following steps: (S) Search, (AL) Appraisal, (S) Synthesis and (A) Analysis. Data extracted from these eight articles were subjected to reflexive thematic analysis, through which patterns were identified to examine the use and impact of VR on the PWB of hospitalised patients with serious illnesses. The thematic analysis process involves data gathering and familiarisation, code identification, and formulating and refining various themes to produce a thematic analysis report.

Results: The themes that emerged from the analysis were (i) positive psychological effects (with sub-themes including the effectiveness of VR in improving psychological symptoms, its role as an equivalent or adjunctive treatment, and symptom reduction), (ii) perceptions and the adoption of novel technology, (iii) characteristics that influence the effectiveness of VR, and (iv) statistical and practical applicability and diversity of VR.

Conclusion and recommendation: The use of VR to increase the PWB of hospitalised patients is a relatively recent innovation. Nevertheless, the themes identified in this study indicate that the use of VR within the context of hospitalised patients can benefit their psychological functioning, ultimately contributing to an improvement in their overall PWB. Further in-depth studies are needed to provide a comprehensive conclusion on the potential benefits of VR on the PWB of hospitalised patients dealing with serious illnesses.

1. Introduction

Experiencing illness and hospitalisation is seldom a pleasant experience, particularly in regular circumstances. Most hospitalised

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patients are confronted with serious illnesses [1]. Serious illness encompasses health conditions characterised by a heightened risk of mortality, compromised functionality, diminished quality of life, and significant burden both on the affected individual and their caregivers [2]. Hospitalised patients struggling with severe illnesses often endure substantial psychological distress and disruption [1,3–5]. These individuals frequently contend with physical pain and often experience a deteriorated psychological state [5,6]. Among the common psychological challenges observed in hospitalised patients with serious illnesses are anxiety, depression, lower quality of life, post-traumatic stress disorder (PTSD) and a sense of identity loss [3–5]. These psychological challenges tend to have adverse effects on the psychological well-being (PWB) of hospitalised patients with serious illnesses [5,7,8]. Hospitalisation further complicates patients' abilities to adapt to and cope with the newfound reality of illness and the path to recovery [9]. Moreover, the circumstances surrounding hospitalisation can vary significantly, with additional factors influencing patients' PWB, including the initial admission process, length of admission, and the possibility of readmission [9]. A growing body of evidence highlights the significance of improving PWB in hospitalised patients, as it is associated with reduced mortality risk, decreased levels of anxiety and depression, and an overall increase in quality of life [10–12]. Furthermore, studies have shown that Virtual Reality (VR) can be an innovative tool in improving the PWB of hospitalised patients [13–15].

PWB is a multifaceted aspect of overall well-being that entails optimal psychological functioning, the experience of positive and negative emotions, and how individuals perceive these experiences [16–18]. In essence, PWB represents a positive psychological state associated with overall happiness and satisfaction with life [19], encompassing positive functioning at both individual and interpersonal levels [20]. PWB is essentially individuals' perception of how well their lives are going, incorporating positive emotions, effective functioning, overall life satisfaction, and feelings of accomplishment [21]. Maintaining PWB requires individuals to effectively manage and cope with negative or painful emotions and experiences [21,22]. Furthermore, PWB includes hedonic and eudaimonic happiness and resilience [17,18]. Hedonic well-being refers to the subjective feelings of happiness, including emotional components (having high positive affect and low negative affect) and cognitive components (levels of life satisfaction) [23]. Eudaimonic well-being centres around the purposeful aspect of PWB [17,18]. This study used the eudaimonic conceptualisation of well-being, which emphasises finding purpose and meaning through self-actualising and striving to achieve personal potential [18]. Additionally, PWB comprises six distinct dimensions: (i) Autonomy, (ii) Environmental Mastery, (iii) Personal Growth, (iv) Positive Relations with Others, (v) Purpose in Life, and (vi) Self-Acceptance [17]. These dimensions often become compromised due to the isolating and disruptive nature of hospitalisation [1,3–5]. Hospitalised patients often question their level of control over their situation and the purpose of their illness [24]. The hospital environment can be challenging for individuals to flourish in, making it crucial to address eudaimonic well-being [5,7,8]. Virtual reality has proven to be an effective tool in enhancing PWB amongst hospitalised patients by addressing various forms of psychological distress, as supported by the dimensions mentioned earlier [13–15].

In the healthcare environment, patients often receive contemporary treatment, frequently using innovative technology [1,25–27]. The use of technology in caring for and treating hospitalised patients with serious illnesses extends beyond enhancing physical well-being to enhancing PWB [15]. Studies have indicated that patients hospitalised with diverse conditions such as cancer, inflammatory bowel disease, ICU admissions, stroke recovery, spinal cord injuries, and dementia have reported increased levels of PWB after using VR to address their psychological needs. This, in turn, has positively impacted their psychological functioning [5,7,13,15,26,28–30]. Beyond its effectiveness in enhancing the psychological functioning of hospitalised patients, VR has also been shown to increase motivation and enhance perceptions of recovery [10–13]. Moreover, the use of VR has been perceived well by numerous healthcare professionals, patients, and caregivers [5,7,13,15,26,28–30]. Treatment plans can be intensive and highly demanding for individuals to endure [31,32]. As a result, distraction offers subjective relief and a sense of ease during intensive treatments while hospitalised [31]. Various methods and tools, including VR, serve as distractions that alleviate the adverse effects of intensive treatments during hospitalisation [31]. This type of distraction diverts attention from the intense focus on ongoing treatment, thereby subjectively reducing the negative effects of intensive treatment and associated stress [31,32]. VR has also been effectively employed during venipuncture procedures with cancer patients, resulting in decreased levels of fear, stress, and pain during these intensive treatments [33–35]. Furthermore, VR treatments have been showcased as effective in treating specific phobias, agoraphobia, and social phobia [36]. VR aids in reducing neuropathic pain associated with spinal cord injuries [33] and holds significant potential in managing psychological symptoms [31,32,36].

VR, an evolving technology aimed at enhancing PWB, is currently the subject of growing interest [25–27]. Studies indicate that VR can effectively improve the PWB of hospitalised patients dealing with serious illnesses by addressing various psychological stressors [15,29,30,37]. VR integrates diverse technologies to create a virtual environment that is convincingly immersive [4]. VR provides an interactive and sensory-stimulating experience, stimulating multiple senses [38]. The stimulation involves the primary senses (visual, auditory, and tactile) to offer a balance of both stimulating and calming sensory experiences [39]. This sensory experience created by VR technology has been used to enhance the PWB of hospitalised patients and alleviate psychological distress [28]. Although VR's potential as a tool for enhancing psychological functioning is being explored globally in various contexts, a limited number of studies have applied VR to enhance PWB [40]. A review of all the databases used in this study for data collection confirmed a dearth of research on VR as a tool for enhancing PWB. VR presents a creative and adaptable approach to increase the PWB of hospitalised patients. Consequently, VR has the potential to be adapted and modified to be used for various illnesses and specialised units, with the possibility of global integration [5,13,30]. Therefore, enhancing PWB is of great importance [13–15]. The global effect of positive PWB could lead to sustainable positive development in numerous domains and systems [41,42]. The expanding modern field and VR's potential for enhancing PWB in multiple hospitalised patients' treatments must be critically examined to provide in-depth insights into VR's current impact on PWB [13,42].

Thus, this study aimed to critically review existing research regarding the use and impact of VR on the PWB of hospitalised patients with serious illnesses. A critical review was used in this study to assess and evaluate existing research [43] regarding the impact of VR

on the PWB of hospitalised patients with serious illnesses. This approach goes beyond a mere description or summary of pertinent literature findings. It encompasses a method involving analysis, synthesis, and the presentation of findings. Furthermore, the critical assessment of the quality of selected studies requires rigorous research, abstract thinking, and an in-depth understanding of the topic [44]. A critical review aims to critically appraise and synthesise the current state of knowledge relevant to the topic of interest [43]. This will allow multidisciplinary readers to assess and gain greater clarity and a deeper understanding [43–45] of the current value of using VR for enhancing the PWB of hospitalised patients. This qualitative composition and analysis will allow the findings and value of this study to lead to potential practical implications and future research studies for a multidisciplinary and multicultural application by identifying the gaps within this context. Due to the lack of current research on the use of VR within hospitalised settings, especially in relation to PWB in the South African context, there is a clear knowledge gap on how VR technology works in different contexts. As this is a new and emerging technology, the research lacks the application, benefits, and potential drawbacks in various contexts. Critically reviewing the current state of the available data may lead to addressing this gap in the future.

2. Research methodology

2.1. Research approach and design

This study followed a qualitative research methodological approach [44,45]. It used the critical review approach of De Klerk and Pretorius (2019) [43] as the research design to critically review existing literature and research on the topic. De Klerk and Pretorius's (2019) [43] recently developed guidelines for critical reviews of psychological research enabled the authors to evaluate the quality of existing relevant studies regarding the impact of VR on the PWB of hospitalised patients dealing with serious illnesses. A critical review allowed for an unbiased, critical assessment of a broad research idea proposed by comparing multiple scholarly studies conducted on the topic [43]. Consequently, a critical review enabled the collection of qualitative data, leading to a deeper understanding [43] of the efficacy and practical application of VR on the PWB of hospitalised patients in a comprehensive manner. This qualitative approach allowed the authors to explore and describe scientific literature, delve further into the subject matter, and critically assess the quality and effectiveness of the available literature [43–45]. Furthermore, a qualitative approach helped consolidate the existing data from multiple studies, offering a valuable, robust, in-depth, and critical summary of the topic. This structured method uses detailed processes to achieve a comprehensive literature review [43,46,47], taking into account principles such as well-defined goals, reproducibility, a broad and inclusive search, and a systematic, synthesised approach to organising the study [43,48–50]. The following seven-step process of De Klerk and Pretorius (2019) [43] was followed: (1) selecting a suitable topic to review and then defining the topic; (2) collecting relevant sources of a scientific nature; (3) excluding and including relevant sources; (4) extracting data; (5) analysing and synthesising the data; (6) presenting and discussing the findings; and (7) making conclusions and recommendations.

2.2. Procedure

This research study obtained ethical clearance from the General and Human Research Ethics Committee (GHREC) of the University of the Free State with ethical clearance number UFS-HUM-2014-68/1806/21/22. The first author conducted the primary searches and served as co-coder and co-analyst. The second author served as a co-coder and collaboratively analysed the collected data and sources. Both authors collaborated to derive, discuss, and reach consensus on codes and themes through critical discussions, feedback, and ongoing communication. The second author critically reviewed the research article in its totality.

2.3. Trustworthiness and rigour

Trustworthiness and rigour are integral to the quality of a study, specifically whether the methodology and analysis are done with confidence, truthfulness, credibility, accuracy, meticulousness, and transferability [51]. In order to ensure trustworthiness and rigour in this study, four specific processes were adhered to: credibility, transferability, dependability, and confirmability [51].

Credibility focuses on the accuracy of the study's findings and relies on sound research methods [51]. Therefore, a well-established research methodology assisted in ensuring credibility. Furthermore, credibility was increased through prolonged engagement, understanding and persistent observation of the relevant literature [51]. This study reinforced credibility by ensuring that the secondary data aligned with themes and patterns derived from established facts in the corresponding literature. The process of gathering sources and analysing studies was well-documented, and a continuous review system was maintained among the authors. To further ensure the credibility of the researchers themselves, a continuous process of reflexive journaling was adopted, aiding in tracking the authors' evolving thoughts into conceptual understanding while recognising the potential for subjective influence.

Transferability measures the extent to which this critical review can be applied in different contexts, settings, and circumstances related to generalisability and the value of the study [51]. Although complete transferability cannot be definitively proven, the unique contexts revealed in the identified themes from the literature analysis, conducted under various circumstances, demonstrated transferability by including various studies and considering diverse contexts. The methodology and research decisions made at every step were also thoroughly described and discussed between the authors. When addressing the limitations of the study, the authors ensured that the findings were understood in their contextual context before any attempts at future transferability.

Dependability focuses on the consistency and reliability of the results of the study [51]. Ensuring dependability started with the precise recording of methods used for data collection, analysis, and interpretation. The entire research process was documented in detail to ensure adherence to sound research practices. The SALSA method [44] and the six steps of thematic analysis, as outlined by

Braun and Clarke (2006) [52], were followed to ensure that the process was grounded in data and not influenced by the biases of the authors. The SALSA method [44] offers a framework for search, appraisal, synthesis, and analysis to determine specific search protocols for secondary data that guarantees methodological accuracy, systematisation, exhaustiveness, and reproducibility [44]. The six steps of thematic analysis, as outlined by Braun and Clarke (2006) [52], offer a highly flexible approach that can provide rich, detailed, and complex accounts of key features from various studies in the form of derived themes, enhancing the potential for replication by other researchers and generating consistent results [51].

Confirmability seeks to establish that biases do not influence the study and that findings objectively reflect the collected information [53]. An audit trail was employed to ensure confirmability. This trail allows readers to track the research process through descriptive and step-based decision-making processes. This approach helps confirm that the results are consistent and objective [53]. Furthermore, confirmability was also achieved by following the steps proposed by De Klerk and Pretorius (2019) [43] for conducting a critical review in a detailed manner.

2.4. Data collection and extraction procedure

Given the importance of an extensive literature retrieval process in conducting a critical review, computerised searches were carried out by the first author. The following databases were used to search for and identify sources, namely EBSCOHost, Psych EXTRA, Academic Search Ultimate, CINAHL with Full Text, MEDLINE, MEDLINE with Full Text, APA PsycInfo, E-Journals, Business Source Ultimate, Health Source: Nursing/Academic Edition, OpenDissertations, Communication & Mass Media Complete, GreenFILE, Health Source – Consumer Editionmic Edition, Google Scholar, and Semantic Scholar. The searches were not limited to these databases; instead, these databases delivered relevant peer-reviewed sources based on the search and inclusion criteria. The sources used were identified using keywords and combinations of keywords: virtual reality; psychological well-being; hospitalised patients; virtual reality AND psychological well-being; virtual reality AND patients; psychological well-being AND patients; and virtual reality AND psychological well-being AND patients. The first author conducted the searches, and the second author supervised and monitored the review process.

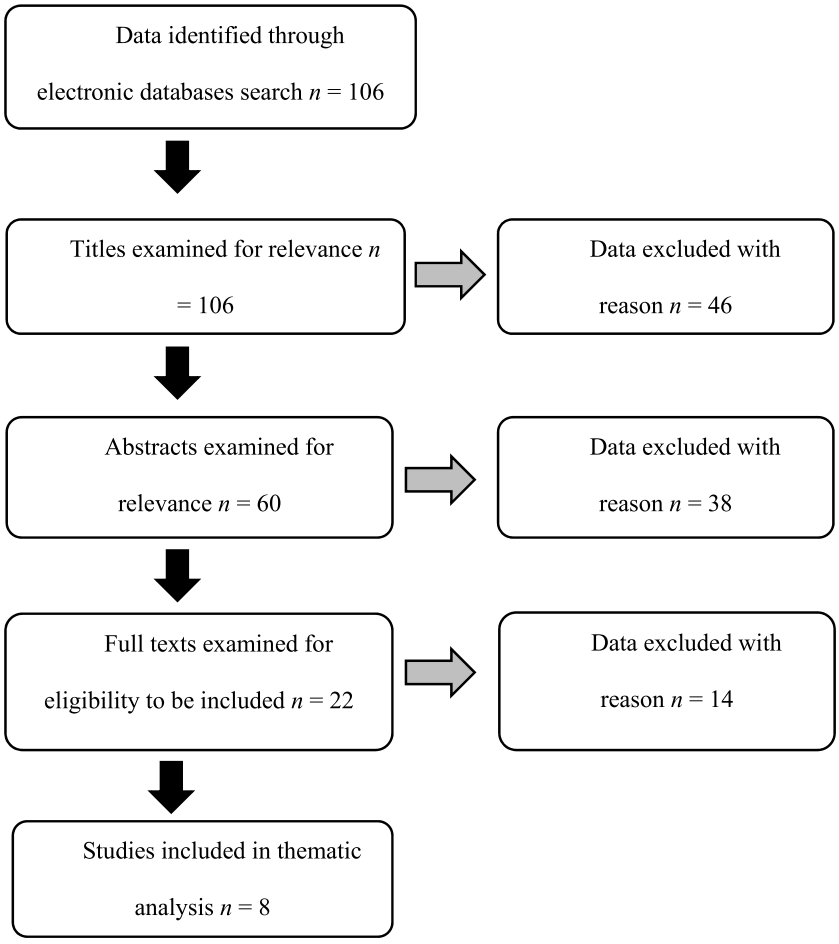

Fig. 1. SALSA process of selecting sources.

The data search, synthesis, and analysis followed the Search, Appraisal, Synthesis, and Analysis (SALSA) analytical framework [44]. The inclusion criteria consist of the following: Full-text literature studies were incorporated in this review because they offer comprehensive, detailed descriptions of complete studies, which were essential for this critical review. The selected studies included peer-reviewed articles, books, dissertations, and theses published between 2003 and 2022. Including recent literature ensured that the extensive literature considered is currently applicable and maintains publication relevance. The inclusion of various types of studies, all of which were peer-reviewed, enhanced the data quality and scientific rigour of the review, adhering to ethical considerations and promoting the inclusion of high-quality, reputable sources. The study included quantitative, qualitative, review, and mixed-method studies to comprehensively examine all relevant knowledge sources on the topic. The exclusion criteria followed as: Non-peer-reviewed articles, non-academic sources (such as magazines and conference proceedings), and studies published in languages other than English were excluded. Only studies in English were included because the researchers' language proficiency and comprehension were limited to English, and translating the material would have incurred significant costs and time.

2.5. Analyses of collected data

The collected data were critically and systematically examined through the SALSA method to select appropriate articles for the critical review [44]. The SALSA method allows and aims for a transferable and reproducible process to systematically conduct a critical review [44]. This method includes the following step-by-step process: (S) Search (which entails finding the essential data about the topic); (AL) Appraisal (which refers to assessing exclusion and inclusion criteria to ensure that only scientifically valid studies are included in the review); (S) Synthesis (to identify patterns through thematic analysis); and (A) Analysis (making sense of and interpreting the identified patterns and themes) [44]. The database search yielded 106 identified studies, of which eight were included. The flowchart in Fig. 1 depicts the detailed process followed in this study.

During the initial search of databases, characteristics of studies such as their publication type, publication date, publication language, ability to access publications, and exclusion of exact duplicates were analysed and considered based on the above-mentioned inclusion and exclusion criteria. A total of 106 initial sources relevant to the research topic were derived and reviewed using the abovementioned search criteria and keywords. The titles of these 106 sources were examined for relevance, and 46 sources were excluded. The titles were examined for the presence of various forms of VR, the presence of PWB or related impact on psychological symptoms and the presence of hospitalisation or serious illness. The abstracts of the remaining sources were then examined for relevance, and a further 38 sources were excluded. The abstracts were further examined to include the relevant constructs, including participant characteristics such as the presence of a severe illness. Methodological details were also examined, looking at the forms of treatment, interventions, and measurements as well as the research aims and outcomes in order to ensure that the included studies include the assessment of VR effects. The remaining sources were then fully examined for relevance and eligibility by looking at the presence of all the abovementioned characteristics as well as considering the presence of statistical power and internal and external validity, and 14 sources were excluded. The remaining eight eligible sources were included in this critical review. The review process therefore included evaluating titles, abstracts, and full texts. Data analysis involved exploring various aspects to determine what should be excluded or included in the study. Exclusion and inclusion criteria were based on several factors, including participants' characteristics, sample types, the presence of serious illness, treatment plans, and hospitalisation status. Descriptive characteristics of studies entailed publication type, publication date, publication language, ability to access publications, exclusion of exact duplicates, forms of VR, and the presence of PWB or related impact on psychological symptoms. An organised record of identified sources was maintained and used to exclude duplicates. Methodological details entailed study designs, forms of treatments and interventions, measurements, outcomes, research aims, and VR-exclusive characteristics (immersive/non-immersive and type of device). The assessment of VR effects (both significant and non-significant findings) considered the presence of statistical power and internal and external validity.

Certain methodological limitations or biases may occur within critical reviews, such as excluding certain literature (selection bias). However, as detailed above, this possibility was counteracted and mitigated by using the SALSA method to ensure that a robust and exhaustive synthesis and analysis of the existing literature was done whilst minimising any potential biases [44] as well as following the detailed steps proposed by De Klerk and Pretorius (2019) [43] for conducting a critical review and the six steps of thematic analysis, as outlined by Braun and Clarke (2006) [52]. Therefore, the entire research process shows a clearly documented trail that was grounded within the data, and the authors' influences or potential selection biases were mitigated. This trail allows for the confirmation of consistent and objective results without potential biases.

The collected data was subjected to synthesis and analysis, contributing to addressing the research question. This data was then included in the process of thematic analysis, involving repetitive engagement and interpretation, ultimately leading to the generation of codes and themes. Thematic analysis [52] was used to identify and report on various themes and patterns identified in the secondary data reviewed. The authors followed the six steps of thematic analysis as outlined by Braun and Clarke (2006) [52]: (1) gathering data and becoming familiarised with the concepts related to the research question and how these concepts relate to each other, (2) identifying preliminary data codes that correspond across the collected data, (3) outlining and organising the most critical findings and patterns into different coherent themes, (4) refining and connecting the most appropriate themes, (5) structuring and naming the themes concerning the research question, and (6) producing the thematic analysis report [52].

During data synthesis, codes and themes were characterised and prioritised based on their significance and the extent to which they appeared consistently in the initial codes across various sources. When there was substantial overlap in coding, these commonalities were aggregated into initial themes. These themes were subsequently subjected to further analysis and refinement to ensure they were coherent, distinctive, and representative of the data. The themes were then defined and reported on. Coding involves some degree of

Table 1
Data extraction table.

Author(s) and Title	Methodology	Sample	Result/Findings	Limitations and Recommendations.
Giachero, A., Calati, M., Pia, L., La Vista, L., Molo, M., Rugiero, C., Fornaro, C., & Marangolo, P. (2020). Conversational therapy through semi-immersive virtual reality environments for language recovery and psychological well-being in post stroke aphasia	*Research aims and questions*: Does conversational therapy delivered via semi-immersive VR environments enhance language recovery in chronic post-stroke aphasia? Do therapy benefits generalise to measures of communication efficacy and psychological well-being? Is VR therapy equivalent to or more effective than conventional training? *Design:* Randomly assigned two groups, pre-post-test. NeuroVR 2.0 open-source software was used. *Measures:* • Aachen Aphasia Test (AAT). • Conversation Analysis Profile for People with Aphasia test (CAPPA test) • Visual Analogue Self Esteem Scale • WHOQOL Scale (Mood Scale)	36 patients were recruited from the neurological departments of different hospitals in Turin. The inclusion criteria were fluent users of Italian, premorbid right-handed, a diagnosis of aphasia due to a single left hemisphere stroke occurring more than six months before the study; absence of cognitive impairment; ability to follow instructions; no Hemi spatial neglect; no articulatory disorder; no uncorrected visual impairment (self-report); and no hearing loss (screened via pure tone audiometry).	There were significant gains in self-esteem and emotional mood state. Interestingly, the within-subject comparisons revealed that the improvement in the different areas was distributed over far more language, communicative, and psychological aspects in the VR group than in the control group. The VR training positively impacted three out of six tasks of the AAT test (repetition, written language and oral comprehension), while in the control group, only on the repetition task. Concerning the CAPPA test, the conversational approach resulted efficacious in the sample group's communicative abilities independent of the presence of VR support. Still, it impacted across the different areas (i.e., language ability, self-correction, and turn-taking) only in the VR group. Findings show significant effect sizes after the use of VR training that positively impacted three out of six tasks on the AAT (Aachen Aphasia Test), namely repetition (0.559), written language (0.552) and oral comprehension (0.462) whilst in the control group the only significant effect was on the task of repetition (0.505). Regarding the CAPPA test (Conversation Analysis Profile for People with Aphasia) test, both the control group and VR group effect sizes were similar; however, within the VR group, the impact was spread across different areas, namely language ability (0.740), self-correction 0.578), and turn-taking (0.456).	*Limitations*: Although the sample size is considered small, it is more significant than in previous studies. Moreover, the time post-stroke comparison revealed that, although all patients' Neurology was in the chronic phase (>36 months), the VR group was minor chronic than the control group. Thus, inconsistencies may have occurred. *Recommendations*: Further research is needed considering other clinical populations, larger sample sizes, and comparative studies.
Tennant, M., McGillivray, J., Youssef, G. J., McCarthy, M. C., & Clark, T.-J. (2020) Feasibility, acceptability, and clinical implementation of an immersive virtual reality intervention to address psychological well-being in children and adolescents with cancer.	*Research Aim*: To examine multiple critical user perspectives on the acceptability and feasibility of an immersive VR therapeutic intervention for use with hospitalised patients with cancer *Design*: This mixed-methods study reports Stages 1 and 2, quantitative and qualitative data related to VR feasibility	Convenience sampling methods were used to obtain a sample of ninety oncology inpatients (7–19 years). Stage 1 eligible participants were multidisciplinary oncology patients. Stage 2 eligible participants were oncology inpatients (7–19 years and at least one-month post diagnosis) and	Results indicated favourable perceptions from health care professionals concerning ease of use and usefulness of VR and had positive intentions to use it in the future. Parent caregivers reported high acceptability of VR for their hospitalised children. Patients reported high satisfaction with the VR intervention with minimal	*Limitations:* Most participants had minimal knowledge or exposure to VR before the opportunity provided by this study. Though possibly representative of the relatively novel nature of VR, the involvement of primarily novice VR users may affect the generalisability of findings regards the intention to use.

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Table 1 (*continued*)

Author(s) and Title	Methodology	Sample	Result/Findings	Limitations and Recommendations.
	and acceptability. *Measures:* Oncology health care practitioners (HPC's) completed a VR evaluation survey developed by the research team based on the technology acceptance model. Child and adolescent participants were subjected to a subjective rating of enjoyment with VR intervention; *Child Simulator Sickness Questionnaire* and open-ended questions were utilised to allow for qualitative assessment. The *Abbreviated Acceptability Rating Profile* was used to evaluate parents' perceptions of the acceptability, helpfulness, and effectiveness of the VR intervention	primary caregivers, who were consecutively recruited from the oncology ward. Patients receiving palliative care or who had significant neurological or developmental difficulties or were medically unstable were excluded	adverse effects. Tennant et al. (2020) findings indicate a clear acceptance of VR technology. The mean score for the Perceived Ease of Use Scale was 5.73 (SD = 0.78; maximum score is 7 = extremely likely); the Perceived Usefulness Scale was 4.81 (SD = 1.00). The overall mean total TAM score (Perceived Usefulness and Perceived Ease of Use scales combined) was 5.28 (SD = 0.72).	*Recommendations*: As VR becomes more widely accessed, further research with patients will be needed to confirm findings and adjust implementation strategies accordingly.
Lewandowski, K., Kaniewska, M., Rosołowski, M., Kucha, P., & Rydzewska, G. (2021). The use of Virtual Reality to reduce stress among inflammatory bowel disease (IBD) patients treated with vedolizumab	*The research aims*: The primary purpose was to evaluate whether VR could decrease stress and anxiety related to a medical procedure. The second purpose aim was to assess the safety of the VR. *Design*: A randomised, controlled, single-centre clinical trial. *Measures*: Standardised questionnaires for attitude to drug administration sessions, how user-friendly the application measures are subjective psychological indicators and the sense of presence and symptoms related to simulator use.	90 patients with IBD treated with vedolizumab were enrolled and randomised in a 1:1 allocation to either the VR immersion group or the routine-treated group	A statistically significant improvement in well-being and psychological comfort ($p = .046$), the feeling of relaxation ($p = .046$), a sense of influence on the treatment process ($p < .001$), improved perception of the way the drug works ($p < .001$), enhanced positive attitude while waiting for the next administration of the drug ($p = .026$), and increased motivation for treatment ($p = .026$) was noticed in the intervention group. There were no statistically significant differences in the incidence of complications or symptoms in the intervention and control groups.	*Limitations*: This was a single-centre, randomised trial, but not blinded study. Second, the study's results could not be easily generalised to the entire population of patients treated with biologics since the only device used was dedicated to vedolizumab.
Vlake, J. H., Van Bommel, J., Wils, E.-J., Korevaar, T. I. M., Bienvenu, O. J., Klijn, E., Gommers, D., & van Genderen, M. E. (2021). Virtual reality to improve sequelae of the postintensive care syndrome: A multicenter, randomized controlled feasibility study.	*Research aim*: The aim of this study was to explore patient-related determinants of ICU-specific virtual reality, such as the timing of patient's self-reported readiness to initiate virtual reality and the number of desired sessions and safety, and to explore the effects of ICU-specific virtual reality on mental health *Design*: A multicenter, randomized controlled feasibility study. *Measures*: Immersive Tendencies Questionnaire (ITQ). Igroup Presence Questionnaire directly after VR exposure. Cybersickness was measured using the Simulator Sickness	50 Patients at the ICU at a university teaching hospital and a secondary care hospital in Rotterdam, The Netherlands who experienced consecutive mechanically ventilated patients with sepsis or septic shock.	ICU-specific virtual reality is a feasible and acceptable novel intervention that could be used during recovery from an episode of critical illness in the ICU. Sepsis-specific ICU-VR intervention improved psychological recovery and mental quality of life in sepsis survivors after ICU treatment. Findings showcased a decrease in PTSD scores ($\beta = -0.04$ [95 % CI, −0.07 to −0.01]; pTime = 0.02) and depression scores ($\beta = -0.03$ [–0.05 to −0.02]; pTime <0.001) over time for all patients however, PTSD decreased more in the ICU-VR group than in the control	*Limitations*: A future, adequately powered study should confirm whether virtual reality is able to improve mental health and quality of life.

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Table 1 (*continued*)

Author(s) and Title	Methodology	Sample	Result/Findings	Limitations and Recommendations.
	Questionnaire directly after VR initiation. Changes in vital signs were assessed during the VR intervention using heart rate, respiratory rate, oxygen saturation, and mean arterial pressure. Psychologic sequelae were expressed as the severity of PTSD- and depression-related symptoms assessed using the Impact of Event Scale-Revised (IES-R) and the Beck Depression Inventory (BDI) II, respectively. Health-related quality of life (HRQoL) was assessed using the Mental Component Scale of the ShortForm 12 (MCS-12) and the Physical Component Scale of the Short-Form 12 (PCS-12) scores and the European Quality of Life 5D (EQ-5D) questionnaire.		VR group ($\beta = 10.87$ [3.73–18.01; pRandomization< 0.01) and ICU-VR resulted in lower depression scores in the ICU-VR group than in the control VR group ($\beta = 5.05$ [1.31–8.79]; pRandomization $= 0.01$). These effects were maintained throughout the study period. The findings furthermore illustrated that mental quality of life was higher in patients in the ICU-VR group than in patients in the control VR group (7.65 [–12.10 to −3.19]; pRandomization <0.01), and this effect persisted throughout the follow-up period.	
Rose, V., Stewart, I., Jenkins, K. G., Tabbaa, L., Ang, C. S., & Matsangidou, M. (2021). They are bringing the outside in: The feasibility of Virtual Reality with people with dementia in an inpatient psychiatric care setting.	*Research aim*: Examining the feasibility of virtual reality within an inpatient psychiatric care setting was explored. *Design*: A mixed-methods design. *Measures*: Measured affect and behaviour using the *Observed Emotion Rating Scale, Overt Aggression Scale-Modified for Neurorehabilitation* and *St Andrew's Sexual Behaviour Assessment*. Thematic analysis was conducted following semi-structured interviews. Caregivers who worked at the hospital supported people with dementia throughout the process and were interviewed for their views on Head-Mounted Display-Virtual Reality (HMD-VR) use with people with dementia.	Eight people with dementia and 16 caregivers were recruited from a UK hospital specialising in progressive neurological conditions.	Overall, the HMD-VR experience positively impacted people with dementia, with significant improvements observed from before to after HMD-VR exposure in pleasure and alertness and during HMD-VR exposure for fun. The current study found no adverse effects in fear/anxiety, sadness or anger. The qualitative data of the reported experiences of using HMD-VR from the perspective of the people with dementia and the caregivers supporting them, in summary, entails participants talking about their HMD-VR expertise and experiences in technology acceptance, the opportunities generated for user well-being and the importance of individual preferences. The findings indicate a statistically significant effect on pleasure ratings before (Mdn = 1.250), during (Mdn = 2.000) and after (Mdn = 1.750) HMD-VR exposure, v2 (2) = 8.000, p = .018. on the Friedman test. The Wilcoxon signed-rank tests revealed a significant increase in pleasure from before (Mdn = 1.250) HMD-VR to during (Mdn = 2.000) HMD-VR exposure Z =	*Recommendations*: The therapeutic benefit of HMD-VR compared to other person-centred interventions, the potential for personalisation of VRs and the refinement of available VR technologies still warrants further investigation.

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Table 1 (*continued*)

Author(s) and Title	Methodology	Sample	Result/Findings	Limitations and Recommendations.
			−2.060, p = .039 and from before (Mdn = 1.250) to after (Mdn = 1.750) HMD-VR exposure Z = −2.060, p = .039. Furthermore, findings indicate that ratings of general alertness significantly differed between before (Mdn = 4.500), during (Mdn = 5.000) and after (Mdn = 5.000) HMD-VR exposure, v2 (2) = 6.300, p = .043. Wilcoxon signed-rank tests revealed a significant increase in general alertness from before (Mdn = 4.500) to after (Mdn = 5.000) HMD-VR exposure Z = −2.060, p = .039.	
Espinoza, M., Baños, R. M., García-Palacios, A., Cervera, J. M., Esquerdo, G., Barrajón, E., & Botella, C. (2012) Promotion of emotional well-being in oncology inpatients using VR.	Research aim: This study focuses on the rise of emotional well-being, specifically, the induction of positive emotions- through two virtual environments in a group of patients little considered so far: hospitalised oncology patients Design: Intervention lasted four sessions (two oriented to joy and two introduced to relaxation) of 30 min, administered along one week. Measures: *Hospital Anxiety and Depression Scale* (HADS) *Fordyce Questionnaire* *Visual Analogical Scales (VAS): Mood* *Visual Analogical Scales (VAS): Physical Discomfort*	The sample comprised 33 patients (69.7 % men, aged 41 to 85). Eligible patients were adult cancer patients with a Karnofsky functional state >50, indicators of adequate organ function, life expectancy >2 months, and were hospitalised for at least one week.	There were significant improvements in distress and level of happiness after the VR intervention. Also, it was detected an overall increase in positive emotions and a decrease in negative emotions after the sessions. Results indicate that there were significant reductions in anxiety and depression levels (depression scale, t = 2747; p = .012 and total HADS, t = 2440; p = .024) and significant increases in happiness levels after intervention (happiness intensity, t = −2116; p = .047 and total happiness, t = −2055; p = .05).	Recommendation: Despite these promising results, it is necessary to corroborate them in studies with larger samples and control groups.
De Araújo, A. V. L., Neiva, J. F., De O., Monteiro, C. B., De M., & Magalhães, F. H. (2019). Efficacy of Virtual Reality rehabilitation after spinal cord injury: A systematic review	Research aim: Aims to investigate the possible benefits and effectiveness of VR-based repair in individuals with Spinal Cord Injuries (SCI). Design: Systematic Review	An electronically systematic search was performed in multiple databases (PubMed, BVS, Web of Science, Cochrane Central, and Scielo)	Although the current evidence is limited, the findings suggest that VR-based rehabilitation in subjects with SCI may positively affect aerobic function, balance, pain level, and motor function recovery, besides improving psychological/motivational aspects. Results showed a statistically significant (p < .05) short-term improvement in motor function, aerobic performance, balance, pain, and psychological aspects. Only three studies reported effect sizes which ranged from low to large treatment effects (Cohen's d values ranged from 0.41 to 1.95 and eta-squared values from 0.11 to 0.95). In addition, statistically significant long-	Limitations: Although an extensive search in the published and unpublished literature was conducted, some relevant studies might not have been identified, and publication biases may exist in this field of research. It was impossible to perform a meta-analysis because of the heterogeneity of outcome measures and VR protocols, and the findings are based on studies with various methodological qualities. They should therefore be interpreted with caution in terms of generalisability.

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Table 1 (*continued*)

Author(s) and Title	Methodology	Sample	Result/Findings	Limitations and Recommendations.
			term effects were observed on motor function, balance, and pain. As well as subjective results about positive VR motivational aspects such as better mood, high enjoyment and improvements in satisfaction were reported in some studies.	
Reynolds, L. M., Cavadino, A., Chin, S., Little, Z., Akroyd, A., Tennant, G., Dobson, R., Broom, R., & Gautier, A. (2022). The benefits and acceptability of Virtual Reality interventions for women with metastatic breast cancer in their homes: A pilot randomised trial.	*Research aim*: The purpose of this pilot study was to assess whether VR should be pursued as a feasible and acceptable adjunctive therapy to alleviate physical and psychological symptoms in women with metastatic breast cancer (MBC) *Design:* A mixed-methods, crossover design integrated pre-intervention, post-intervention, and 48-h follow-up *Measures*: The primary outcome measure was quality of life as measured by the *EQ-5D-5L* *Functional Assessment of Chronic Illness Therapy Fatigue Scale* (FACIT-Fatigue) *The Brief Pain Inventory – Short Form* (BPI) The 21-item short version of the *Depression, Anxiety, and Stress Scales* (DASS-SF)	Women with MBC were invited to participate through the mailing lists of Breast Cancer Foundation NZ (BCFNZ) and Sweet Louise (a charity support service for people with MBC). In this study, a sample of 30 participants was determined.	Significant improvements post-intervention and 48 h later were demonstrated for quality of life, fatigue, pain, depression, anxiety, and stress. The results demonstrate that VR experiences offer enduring benefits to the physical and psychological well-being of women with metastatic breast cancer. Findings indicate significant improvements post-intervention and 48 h later were demonstrated for quality of life, fatigue, pain, depression, anxiety, and stress. The results demonstrate that VR experiences offer enduring benefits to the physical and psychological well-being of women with metastatic breast cancer; however, results fall into a small effect size. 0.28–3.80.	*Limitations*: The most crucial issue requiring consideration is the lack of a control group which limits our ability to claim causation of effects.

subjective judgement; however, inter-coder reliability was maintained to uphold the validity of the study. All the derived codes were consistent and uniformly agreed upon by both authors. This consensus ensured that both authors arrived at the same findings, thereby increasing the validity of the derived themes. The data extracted from the sources are outlined in the data extraction table (Table 1).

Table 2
Theme introduction table.

THEMES	SUBTHEMES	DESCRIPTION
Theme 1: Positive Psychological Effect	*Effectiveness of VR in Improving Psychological Symptoms*	This sub-theme focuses on the effectiveness of VR in improving the various psychological symptoms and psychological functioning of hospitalised patients, which could increase their PWB indirectly including looking at the statistical significance of the findings.
	Equivalent or Adjunctive Treatment	This sub-theme discusses and emphasises the use of VR as an adjunctive treatment to be used in conjunction with other treatment/therapy plans to ensure efficacy.
	Reduced Symptoms	This sub-theme explores the lack of negative symptoms experienced by the use of VR, as well as diving into the specificity of the reduction of specified symptoms and how this links to the improvement of psychological symptoms and functioning.
Theme 2: Perceptions and Novel Technology		This theme explores the perceptions of healthcare workers, caregivers and patients on the use of VR whilst also looking at the potential influence of the novelty of VR on the perceptions and possible biases. Furthermore, the discussion on the novelty of the use of VR extends to implementation and the urban VS rural healthcare system.
Theme 3: Characteristics that Influence the Effectiveness of VR		This theme emphasises the unique characteristics that make the use of VR stand out from other modalities and relate to efficacy by looking at the personalisation and immersive aspects of VR.
Theme 4: Practical Applicability and Variety of VR		This theme focuses on the practical effect that the use of VR has on the PWB of hospitalised patients with serious illnesses, as well as looking at factors such as the variety of equipment across the data.

2.6. Findings and themes

The themes and subthemes are outlined in the theme introduction table (Table 2).

The generated patterns the literature informed relevant to this critical review are discussed in themes. These themes relate to the use and impact of VR on the PWB (positive psychological functioning) of hospitalised patients.

2.7. Theme 1: positive psychological effect

This theme focuses on the effectiveness of VR in improving the psychological symptoms of hospitalised patients, potentially enhancing their PWB. This includes the point of VR versus traditional treatment methods, the reduction of specific symptoms after using VR, and increased motivation regarding treatment.

2.8. Effectiveness of VR in improving psychological symptoms

Giachero et al. (2020) [7] explored the impact of VR on communication efficacy and psychological well-being in post-stroke Aphasia patients. In the treatment group, VR significantly improved communication efficacy and indicated increased self-esteem and emotional gains. These findings demonstrate that VR offered a broader and more widespread range of benefits when used in the treatment group than in the control [7]. Consequently, these findings suggest that VR is a feasible complementary therapy that positively impacts patients [7]. Significant improvements were observed in repetition ($F(1, 12) = 15.211$, $p = .002$, partial $\eta 2 = 0.559$, mean = 52.56), written language ($F(1:12) = 14.792$, $p = .002$, partial $\eta 2 = 0.552$, mean = 55.39) and oral comprehension ($F(1, 12) = 10.291$, $p = .008$, partial $\eta 2 = 0.462$, mean = 59.83). VR training also positively affected language ability ($F(1,12) = 31.277$, $p < .001$, partial $\eta 2 = 0.740$, mean = 39.04), self-correction ($F(1,12) = 19.031$, $p = .001$, partial $\eta 2 = 0.634$; mean = 41.67), and turn-taking (partial $\eta 2 = 0.456$), emphasising its potential to enhance cognitive and psychological functioning [7]. Tennant et al. (2020) [15] discovered that hospitalised cancer patients experienced minimal side effects and reported high satisfaction rates with VR (Perceived Ease of Use Scale ($M = 5.73$; $SD = 0.78$). The Perceived Usefulness Scale was ($M = 4.81$; $SD = 1.00$). The overall mean total TAM score (Perceived Usefulness and Perceived Ease of Use scales combined) was 5.28 ($SD = 0.72$). They further noted an enhancement in emotional regulation, improved mood, and better coping abilities in these patients. In the case of hospitalised patients with IBD, the study by Lewandowski et al. (2021) [13] revealed that VR had a positive impact on well-being and comfort ($p = .046$). The intervention group reported feelings of relaxation ($p = .046$), a sense of control ($p < .001$), and an enhanced positive attitude to medical treatment ($p = .026$) [13]. Moreover, beyond its positive effects on well-being, the intervention group exhibited increased motivation to adhere to the overall treatment plan for IBD after using VR ($p = .026$) [13]. Vlake et al. (2021) [5] found that specific sepsis survivors in the ICU experienced improved psychological recovery and increased overall mental quality of life with VR. Significant results were as follows: a decrease in PTSD scores for the ICU-VR group than in the control VR group ($\beta = 10.87$ [3.73 to 18.01]; pRandomisation <.01) and ICU-VR resulted in lower depression scores in the ICU-VR group than in the control VR group ($\beta = 5.05$ [1.31 to 8.79]; pRandomisation = .01). These effects were maintained throughout the study period. Vlake et al. (2021) [5] found that mental quality of life was higher in patients in the ICU-VR group than in patients in the control VR group ($\beta = 7.65$ [–12.10 to −3.19]; pRandomisation <.01). These results show that VR is a feasible positive treatment for particular diseases and for patients in the ICU. VR also had a positive impact on the pleasure before (Mdn = 1.250), during (Mdn = 2.000) and after (Mdn = 1.750) HMD-VR exposure (v2 (2) = 8.000, $p = .018$)) and alertness levels before (Mdn = 4.500), during (Mdn = 5.000) and after (Mdn = 5.000) HMD-VR exposure (v2 (2) = 6.300, $p = .043$) of inpatient dementia sufferers, as observed in the study by Rose et al. (2021) [30]. Oncology patients reported significant improvements in positive emotions, reduced stress levels, and increased happiness ([26] Results indicated that there were significant reductions in anxiety ($t = 2.440$; $p = .024$) and depression levels ($t = 2.747$; $p = .012$) and significant increases in happiness intensity ($t = -2.116$; $p = .047$) [26]. Patients suffering from spinal cord injuries also reported improved psychological effects following exposure to a VR intervention [28]. De Araújo et al. (2019) [28] conducted a systematic review, finding statistically significant short-term and long-term improvements in motor function, aerobic performance, balance, pain, and psychological well-being in individuals with spinal cord injuries. Only three studies reported effect sizes, ranging from low to large treatment effects (Cohen's d values ranged from 0.41 to 1.95 and eta-squared values from 0.11 to 0.95) [28]. The lack of reported effect sizes may be due to the studies having relevantly low sample sizes and equipment, possibly impacting the analysis context. Reynolds et al. (2022) [29] explored the average decrease across interventions using the difference between the raw pre-intervention and follow-up scores. Women with metastatic breast cancer reported improved quality of life (the change in quality of life across the entire study period was 0.10, which is greater than the suggested cut-off of 0.08) after incorporating VR in their treatment plans, along with a reduction in depression, anxiety, and stress associated with hospitalisation (the gross reductions in depression (7.77), stress (5.90) and anxiety (2.99) [29].

Thus, these findings collectively indicate the overall effectiveness of VR in increasing psychological functioning in numerous cases of hospitalised patients, showcasing the effectiveness of integrated treatment approaches.

2.9. Equivalent or adjunctive treatment

The reviewed data suggests that while VR enhances psychological functioning, it is not an adequate replacement for treatment [7, 28]. Instead, VR plays a broader and more specialised role in addressing psychological aspects, making it an effective adjunctive treatment instead of an equivalent or replacement treatment [7,28]. Consequently, the data highlights that VR is an integral part of a

professional recovery and therapy plan rather than a standalone therapy. Giachero et al. (2020) [7] observed that VR therapy broadened the effects of language and communicative recovery, emphasising its role in enhancing psychological aspects of recovery while still retaining that traditional treatment plans remain just as effective in the broad recovery of post-stroke Aphasia patients. This suggests that VR is integrated and used as an adjunctive therapy to enhance certain recovery domains. Tennant et al. (2020) [15] and Lewandowski et al. (2021) [13] found that the inclusion of VR therapy in standard treatment and recovery plans resulted in a more positive experience and improved psychological functioning in patients, demonstrating that the inclusion of VR in traditional treatment plans results in optimal recovery. Vlake et al. (2021) [5] explored how integrating VR therapy into routine ICU treatment plans enhances mental recovery from ICU treatment. Therefore, showcasing the adjunctive use of VR broadened the focus to include mental recovery and resulted in a more holistic treatment plan. According to Rose et al. (2021) [30], the additional use of VR therapy alongside standard therapy can enhance treatment perceptions and experiences, resulting in more positive effects and overall recovery. According to the data, personalised VR therapy gives patients a sense of autonomy and control over their treatment plans, resulting in increased psychological functioning. The data also illustrates that integrating VR with traditional therapies reduces negative effects and enhances the environmental experiences of patients [26,28,29]. The overall acceptance of this adjunctive treatment method is exceptionally high among patients, medical healthcare workers, and family members, according to the data [5,7,13,15,26,28–30]. Furthermore, Rose et al. (2021) [30] found no adverse effects on fear/anxiety, sadness, or anger after using VR with inpatient dementia sufferers. Giachero et al. (2020) [7] noted that although VR targets different areas of effect, specifically with a more psychological focus, there is no significant difference between the VR and conventional therapy groups in the overall treatment of patients with post-stroke Aphasia. These findings indicate that VR is not a standalone treatment but rather a method of attaining a more holistic therapy to further the field of medical treatments. Thus, VR serves as an adjunctive treatment with a focus on enhancing psychological functioning.

2.10. Reduced symptoms

Tennant et al. (2020) [15] indicated that using VR did not result in adverse effects or added symptoms among patients. In contrast, Lewandowski et al. (2021) [13] found that patients exhibited an increased perception of the effectiveness of administered drugs in terms of treatment and symptom reduction after experiencing VR. Moreover, in patients with spinal cord injuries, VR positively impacted aerobic function, balance, pain management, and motor function recovery [28]. Women with metastatic breast cancer reported reduced fatigue and diminished pain following VR use [29]. Consequently, the data shows that the perceived reduction in physical symptoms among hospitalised patients contributes to a more positive recovery and hospitalisation experience, increasing overall psychological functioning. Cases involving illnesses such as acute COVID-19 have reported a substantially lower quality of life due to the experience of symptoms [54], encompassing both physical and psychiatric symptoms such as anxiety and PTSD [54,55]. The data indicates that the use of VR provides patients with a sense of self-efficacy and control over the treatment plans, reducing the adverse psychological symptoms related to hospitalisation and cultivating coping and resilience skills [9]. Patients also reported that they experienced their treatment plans with greater satisfaction and reduced discomfort due to using VR [13,15,28–30]. The data further demonstrated that the increased reduction of symptoms experienced by patients may decrease their mortality risk and increase their quality of life [10–12]. Consequently, these findings show that using VR to increase psychological functioning becomes valuable during the treatment plan of hospitalised patients.

2.11. Theme 2: perceptions and novel technology

Tennant et al. (2020) [15] found that healthcare professionals held positive perceptions concerning the ease of using VR and its effectiveness in enhancing the psychological functioning of patients. Despite being a novel experience, these healthcare professionals expressed their intent to use VR as a future treatment method [15]. Healthcare professionals encompass all healthcare professionals who provide health care, treatment, and advice based on formal training and experience [15,56]. Additionally, patient caregivers reported the acceptability of VR use in their care of hospitalised children. The patients exhibited high excitement and satisfaction with this new innovative treatment element [15]. Patient caregivers are responsible for addressing the daily needs and tasks of individuals facing short- or long-term limitations due to a serious illness, injury, or disability by providing hands-on assistance [15,56].

Rose et al. (2021) [30] found that participants' discussions about their VR experiences highlighted the significant acceptance rate of the technology. Participants expressed excitement about the opportunities that VR offers for enhancing PWB in the future. Overall, the perception of the impact of VR on the psychological functioning of hospitalised patients seems overwhelmingly positive across the studies [5,7,13,15,26,28–30]. However, the lack of negative findings may be a cause of concern since four studies involved researchers who were directly engaged in developing VR interventions [7,13,15,26]. This involvement could potentially introduce publication bias by showcasing only the favourable outcomes of VR interventions. Nevertheless, the remaining studies, including a systematic review, seem to corroborate the positive perceptions and effects of VR interventions on the psychological functioning of hospitalised patients, thereby decreasing the probability of publication bias. Consequently, the positive perceptions of VR as a novel technology seem to be portrayed as accurate in the data. Furthermore, the possibility of publication bias was mitigated by limiting the initial extensive literature search to recent and applicable sources that were peer-reviewed in order to ensure that the used sources were of quality with scientific rigour and resulted in delivering high-quality and reputable data. While innovative healthcare technologies hold the potential to significantly impact medical practice and patient outcomes, they also present implementation barriers and facilitators [57,58]. As a novel technology, VR may introduce challenges related to competence and maintenance that could affect implementation and treatment in unanticipated ways. Regardless of the potential benefits of using VR to improve the PWB of hospitalised patients, the

novelty of the technology could introduce potential biases. The rapid development of new technologies often occurs faster than the evidence of their efficacy [59,60]. The common perception is that any new technology is immediately more effective [59,60]. These implicit associations or underlying beliefs about novel technology may lead to a biased acceptance or perception of the efficacy of VR use. However, the results from the peer-reviewed, high-quality and reputable sources performed various assessments, as seen in the above-mentioned theme that indicated a positive psychological effect [5,7,13,15,26,28–30], therefore, indicating the effectiveness of the use of VR on the improvement of the psychological factors of hospitalised patients with serious illness mitigating the possibility of the perceptions on VR being influenced by novelty bias. Furthermore, most new technologies are evaluated based on their performance in controlled settings rather than real-world implementation [59,60]. This includes factors such as whether the implementation aligns with the intended use and the presence of regulatory and operational barriers [60]. In order to ensure the effective implementation of healthcare technologies, it is essential to have an adequate number of trained individuals, available resources, and adequate infrastructure [61,62]. Presently, this is not the case for novel technologies such as VR in many hospitals and rural areas. Innovations and healthcare technologies are often only accessible in urban areas, leaving rural settings underserved. This urban-rural divide is a global phenomenon [63]. Rural healthcare settings are characterised by understaffing, inadequate trained staff, insufficient funding, and limited resources, further exacerbating this divide [63]. The implementation of VR technologies in healthcare remains understudied in practice and research [64]. This indicates that VR-trained professionals and VR-integrated infrastructures within the healthcare system are still in their early stages of development in urban environments. However, the prevalence of these technologies may increase due to the reported positive effects and the favourable perceptions of this new technology among all relevant stakeholders [64]. Therefore, even though the enthusiasm for VR might be attributed to its novel nature, a clear interest in future implementation in urban and rural areas is present.

2.12. Theme 3: characteristics that influence the effectiveness of VR

The gathered data highlighted some characteristics of VR that may distinguish it from traditional treatment methods. It also illustrated how VR could be adapted to enhance its effectiveness.

VR proves effective due to its inherent personal immersion and adaptability to various patients and diverse medical conditions [5,30]. VR creates exposure scenarios that immerse patients in customised contexts, offering a personalised treatment feature [30]. This personalisation empowers patients, fostering a sense of control, a feeling of influence on their well-being, and a personalised connection to the treatment plan [13]. Active engagement in the treatment process is essential for motivating patients and enhancing their perception of the treatment plan [13]. This internal locus of control and the feeling of influence over their own well-being often result in better self-assessed mental and physical health and recovery [65]. Patients' perceived sense of control can significantly reduce the presence of various negative psychological factors, particularly distress, anxiety, and depression, during treatment plans [13,65]. Therefore, personalised exposure through VR is essential in attaining optimal treatment plans tailored to individual needs, resulting in the best path to recovery [13].

The reviewed data collectively shows VR's adaptability for various patients and medical conditions, demonstrating that VR is highly adaptable, increasing the scope of possible use [5,7,13,15,26,28–30]. This increased scope of use encompasses a multidisciplinary approach, making it a modality that can be seamlessly integrated into existing healthcare treatment plans, enriching the diversity and customisation of treatments for specific illnesses or patient types [5]. This adaptability, which VR provides above other single modality treatments, may enhance the suitability of treatment plans across a more diverse setting [5,7,13,15,26,28–30]. Investigating these unique characteristics of VR makes it appealing to patients and healthcare workers [15]. Personalised care planning has many benefits, including increasing self-efficacy, empowerment, and improved perceived interpersonal support [66,67]. These benefits, in turn, may reduce the presence of negative psychological factors [13,65].

VR engagement promotes these benefits and enhances motivation to recover and flourish under such circumstances [13]. Engaging with VR resulted in an increased positive attitude while awaiting the next step of the treatment plan [13]. VR is an interactive tool that provides high engagement in treatment plans, creating a motivational environment associated with positive adherence to treatment plans [28]. This motivating attribute that VR-based technology has within treatment and recovery plans over conventional plans emphasises the unique benefits that VR engagement promotes [13,28]. This ultimately results in the best optimal treatment and provokes thoughts on a person-centred treatment approach [67].

Despite the positive attributes of personalisation and adaptability in VR use, it is essential to recognise and address certain challenges that affect the applicability and effectiveness of VR. VR software and equipment can provide varied user experiences, and the content of the VR intervention is a critical factor to consider. While the content can be personalised to some extent, it should still create a pleasurable, calming, and engaging environment [66,67]. This highlights a critical limitation and challenges introduced by personalisation features in VR treatment.

2.13. Theme 4: practical applicability and variety of VR

The reviewed literature presented key findings and practical applications of VR interventions. Giachero et al. (2020) [7] utilised semi-immersive VR scenarios displayed on a 50-inch screen using NeuroVR 2.0 software, recruiting 36 neurological patients in Turin. Their results significantly improved Aachen Aphasia Test tasks, including repetition, written language, and oral comprehension. VR training positively affected language ability, self-correction, and turn-taking, signifying its potential for enhancing cognitive and psychological functions in patients. Tennant et al. (2020) [15] introduced participants to VR technology and found high acceptance levels. The use of VR resulted in positive perceived ease of use and usefulness. Their study involved 90 oncology inpatients, showcasing

favourable beliefs regarding the ease, enjoyment, and usefulness of VR interventions. This interest could lead to broader implementation of VR in healthcare. Lewandowski et al. (2021) [13] employed VR headsets during vedolizumab infusion for IBD patients, reporting statistically significant improvements in well-being, relaxation, treatment perception, and motivation. Their study with 90 IBD patients highlighted the potential of VR in enhancing well-being and reducing stress and anxiety. Vlake et al. (2021) [5] utilised head-mounted VR displays in the ICU, leading to decreased PTSD and depression scores, along with improved mental quality of life. This suggests the potential of VR to enhance psychological recovery and quality of life for ICU patients. Rose et al. (2021) [30] used mobile VR to enhance pleasure and alertness for people with dementia and caregivers. Their findings suggest that VR can improve cognitive functioning and the perception of treatment plans. Espinoza et al. (2012) [26] used a TV screen and computer for interventions, reporting significant reductions in anxiety and depression levels and increased happiness. Integrating VR can offer a holistic approach to improving mental well-being in healthcare. De Araújo et al. (2019) [28] conducted a systematic review revealing positive short-term and long-term effects of VR-based rehabilitation on individuals with spinal cord injuries. VR interventions improved various aspects, including motor function, balance, and psychological well-being. Reynolds et al. (2022) [29] used a Pico Goblin VR headset, demonstrating significant improvements in the quality of life, fatigue, pain, depression, anxiety, and stress for women with metastatic breast cancer. Although the effect size was small, VR provided lasting benefits to patients' physical and psychological well-being. All the VR equipment used semi-immersive visual and audio stimuli with various patient control settings. The equipment and intervention differentiated across studies. The settings and facilities also varied within these studies. Furthermore, although the population consisted of hospitalised patients with serious illnesses, various illnesses have been analysed, with many illnesses and injuries not showcased. Therefore, it is important to consider these variabilities before transferring or generalising the findings of this study to other applications, implementations or comparisons. Despite the studies utilising various VR equipment, settings, and populations, the common theme was the positive psychological impact of VR on hospital patients. This suggests that VR can be a valuable tool in diverse healthcare settings.

2.14. Overview of themes

An exploration of how the abovementioned themes interconnect follows: The first theme addresses the critical review's research aim by looking at the impact of VR on the PWB of hospitalised patients. VR increased the patients' PWB by improving various psychological factors. Thus, the first theme surrounds the positive psychological effect of VR. This directly leads to the subthemes of the effectiveness of VR in improving psychological symptoms and how the use of VR reduces specified symptoms during treatment plans. Furthermore, the subthemes then delve beyond the effectiveness and examine whether VR is an effective stand-alone treatment or enhances current treatment outcomes. It was found to be effective as an adjunctive treatment [5,7,13,15,26,28–30]. After establishing the effectiveness of VR in improving psychological symptoms, the second theme looks at how the use of VR is perceived by healthcare workers, caregivers, and patients. The use of VR was found to be favourable [5,7,13,15,26,28–30]. Theme 3 then explores *why* VR is unique, effective and favourable by looking at unique characteristics. Lastly, theme 4 encompasses the variety of VR equipment and explores the practical applicability of VR on the PWB of hospitalised patients.

Even though the current practical applicability and holistic approach to improving mental well-being within the healthcare setting through the use of VR is illustrated in theme 4 and explores VR's potential for enhancing cognitive and psychological functioning, enhancing well-being, and reducing stress and anxiety as well as improving psychological recovery and quality of life [5,7,13,15,26,28–30], the long-term effectiveness and impact that VR has on the PWB of patients are still under-researched and limited by the lack of current follow-up studies therefore limiting the understanding of a sustained impact.

3. Discussion

VR is no longer limited to the entertainment industry. VR's application has extended to various industries, including clinical and mental health treatment [68]. Key themes arising from this study encompass the effectiveness of VR in producing positive psychological outcomes, the role and function of VR as an adjunctive treatment, its ability to reduce symptoms of hospitalised patients, and the perceptions related to the novelty and customisation aspects of this technology.

VR offers a stimulating experience that can aid as an escape from the unpleasant reality of hospitalisation [1]. However, VR targets a neglected psychological treatment domain [69]. As the themes above show, VR indirectly increases patients' PWB through improved mood, emotional state, quality of life, self-esteem, and coping capabilities. The analysed data indicated a positive increase in the emotional state, mental state and related factors but limited direct links to an improved PWB. PWB is multi-sided and a crucial aspect of overall well-being consisting of psychological functioning, the experience of positive and negative emotions, and the individual's perceptions regarding these experiences [16–18]. Therefore, PWB is indicative of positive psychological positive functioning [19,20]. Eudaimonic well-being centres around the purposeful aspect of PWB [17,18], which emphasises finding purpose and meaning through self-actualising and striving to achieve personal potential [18]. Additionally, PWB comprises six distinct dimensions: (i) Autonomy, (ii) Environmental Mastery, (iii) Personal Growth, (iv) Positive Relations with Others, (v) Purpose in Life, and (vi) Self-Acceptance [17]. This purposeful aspect of PWB links directly to positive levels of functioning, including overall life happiness and satisfaction that supports improved PWB [19,20]. PWB, at its core, can be viewed as how well an individual's subjective view of their overall life is [21]. This entails a positive emotional state and efficient functioning [21,22]. To increase or maintain a positive PWB, individuals must manage and improve their emotional state and ability to cope and decrease negative and painful experiences [21,22]. Therefore, reducing or preventing psychological symptoms/stressors could improve PWB. Giachero et al. (2020) [7] observed increased self-esteem and emotional well-being following VR use. Tennant et al. (2020) [15] found that cancer patients experiencing

hospitalisation demonstrated enhanced emotional regulation, improved mood, and heightened coping abilities after engaging with VR. Vlake et al. (2021) [5] further indicated that the use of VR led to improved psychological recovery and an overall increase in mental quality of life, particularly among specific sepsis survivors in the ICU. Additionally, oncology patients reported significant enhancements in positive emotions, stress reduction, and increased happiness levels after using VR [26]. Women diagnosed with metastatic breast cancer also reported improved quality of life and an elevated mood state following VR use, manifested through a reduction in depression, anxiety, and stress [29].

Thus, the data showed an increase in mood states, self-esteem, emotional regulation abilities, coping abilities, increased relaxation, positive attitudes, sense of control, increased quality of life and reduction of stress after the use of VR [5,7,13,15,26,28–30]. The use of VR resulted in improved psychological recovery from being hospitalised with a serious illness, which resulted in an overall increased mental quality of life and a decrease in negative psychological symptoms such as depression, anxiety, and stress [26,29]. Therefore, VR offers a preventative measure to negative psychological symptoms and thus indirectly links to improved PWB. As individuals' overall well-being increases and negative psychological symptoms decrease, it may improve PWB [21,70,71]. This indicates that further studies in this field are necessary to directly confirm the positive effect of PWB on hospitalised patients with serious illnesses.

The data also showed that VR reduced specific symptoms, such as pain [28]. Furthermore, VR increased the perception and attitudes amongst patients towards their treatment plan while being hospitalised [13]. According to the data, VR is an effective treatment for hospitalised patients with serious illnesses. However, it is more effective as an adjunctive form of treatment than an equivalent treatment [5,7,13,15,26,28–30]. VR is also perceived extremely well by patients, caregivers, and healthcare practitioners [15]. VR is a versatile and adaptable tool for various illnesses and treatments. This is made possible by VR's unique personalisation characteristics [5,30]. The unique personalisation and adaptive characteristics that VR offers also illustrate some challenges in relation to the applicability and efficacy of use. The personalisation versatility is restricted in terms of the aim of the content.

In comparison with more traditional intervention plans, VR not only offers relief from various psychological stressors caused by hospitalisation, isolation and treatment plans for severe illnesses [15,29,30,37], but it also improves a patient's levels of self-efficacy through providing an engaging environment and promotes recovery motivation [10–13]. Hospitalised patients are often concerned about their level of control over their situation and treatment plan [24]. VR technologies create these engaging virtual environments in a convincingly immersive format by providing not only interactive but sensory stimulating experiences senses (visual, auditory, and tactile) whilst maintaining a balance between stimulating and calming experiences [4,38,39]. This immersion empowers patients, creating a sense of control and fostering feelings of influence surrounding their treatment plans [13]. Patients reported that this created a sense of control and significantly reduced the experience of negative psychological factors such as anxiety and depression, amongst other distress during treatment [13,65].

These immersive and personalised characteristics that VR offers set it apart from conventional interventions by giving the patients a sense of control over treatment plans resulting in increased positive functioning and recovery motivation [26,28,29]. However, this is achieved through integrating VR with conventional therapies and treatment plans, and therefore the use of VR is limited to adjunctive therapies. Various VR interventions and equipment can be used due to the diverse nature of VR in various hospital settings and can still result in a mostly significant positive psychological effect on the patients [5,7,13,15,26,28–30]. However, the vast array of situations and illnesses that require hospitalisation can include many other variables. The settings and facilities within hospitalisation are also varied. The variability in these factors often leads to difficulty in maintaining a control group, which causes concern and limits the ability of this critical review to generalise the effectiveness and impact of VR on the PWB of hospitalised patients. Therefore, before considering transferring or generalising the findings of this study to other applications, implementations or comparisons, it is important to consider these variabilities.

3.1. Limitations and recommendations

Regardless of VR's valuable impact on the psychological functioning of hospitalised patients, it is crucial to consider the relevant limitations to achieve transparency and sound ethical practice. VR is still a novel technology, and this novelty could influence its use in the hospitalisation context. It could also impact the generalisability concerning the motives for use. The novelty of the technology could present potential biases. Perceptions of new technology being more effective than conventional methods may be due to implicit accounts or underlying beliefs about technology [59,60]. The lack of negative findings or adverse effects reported in the studies may cause concern due to four studies having had researchers involved in developing VR interventions [7,13,15,26]. This may indicate a limitation in only showcasing the positive findings due to publication bias. This possibility is important to consider but is also reduced by the remaining studies, including a systematic review that corroborates the positive perceptions and effects of VR interventions on the PWB of hospitalised patients. This confirms the lack of adverse effects of VR throughout the data. The findings and themes were based on studies with various methodological qualities. Therefore, interpretations should be considered cautiously, especially concerning generalisability and applicability to local contexts. Looking further into the methodological qualities and rigour, it is also important to note that most studies were experimental in nature [5,7,13,15,26,29,30], with only two studies having control groups [7, 13]. Only a few studies used a pre-post test format [7,13,26,29,30]. It is also important to note that the collected data was limited by the author's language proficiency as well as the cost and time limitations of translations. Therefore, the language of publications may have limited and excluded certain valuable sources from this critical review. The participants in the studies that were reviewed were limited to hospitalised patients, and extracted data only showcased participants with a few select serious illnesses. Therefore, the findings cannot be transferred to all hospitalised patients due to other unknown variables present in various serious illnesses. Furthermore, due to the limitations and shortage of currently available literature, there is a clear lack of diversity in geographical and cultural settings worldwide, as well as a lack of diverse patient populations, especially locally. The efficient implementation, including

staff training, infrastructure and available resources, is also limited, adding to the lack of worldwide applicability. Therefore, generalising the effectiveness of VR on the PWB within hospital settings and especially other settings should be done with caution.

The variety of VR technologies and applications that were used in these studies may lead to unknown extraneous variables that have the potential to influence the results. There is a lack of regulations, standards, and guidelines surrounding the development, utilisation, design, and implementation of appropriate VR technologies and applications [76].

Implementing VR technologies in healthcare is understudied in practice and research [64]. This review also focused on a limited number of sources, specifically concentrating on improving psychological functioning through VR, therefore delimiting the interpretation of the data. Most of the studies in this critical review found only indirect links to PWB. Furthermore, although a thorough and detailed literature search was implemented, possible relevant studies could have been excluded due to potential publication biases in this field. Future studies could confirm and explore the impact of VR on PWB directly and in various contexts outside of hospitalised patients to explore the expansive impact that VR might have on psychological functioning and PWB. This expansive impact could span urban and rural sectors and look at a possible global impact that could enhance the generalisability of the critical review to a more diverse population. It is also important to research how certain cultural factors may impact the perceptions and efficacy of using VR in improving PWB in hospitalised patients and the medical setting more generally. Exploring how VR impacts PWB in hospitalised patients in various contexts, cultures, and countries is underexplored as the use of VR in the medical setting is still in its infancy. VR as a tool to enhance PWB in a South African context needs further exploration [72]. The literature in this study did not include a regional South African context, as all studies were set outside of the local context. The cultural influences and global effects of VR on the PWB of hospitalised patients in a local context give rise to future studies. There needs to be more focus on cultural competence training for healthcare professionals [73]. Cultural competence training is a strategy to provide equal, effective, and quality healthcare services for culturally diverse patients with various beliefs surrounding treatment plans [74]. This is a primary factor in achieving successful and effective integration of VR in a diverse population such as South Africa [74].

4. Conclusion

The use of VR to increase the PWB of hospitalised patients is a relatively new technique. However, the themes that emerged from this study indicate that using VR amongst hospitalised patients leads to positive psychological effects that, in turn, could lead to improved PWB. This critical review, therefore, motivates future research to confirm this positive impact. This also opens up the possibilities for future research on this topic globally or with a specific focus on illness or different settings. Possible gaps in current research could relate to the implementation of VR technologies in urban and rural healthcare settings, confirming the direct impact of VR on PWB, as well as exploring contexts outside of hospitalised patients, such as therapeutic sessions or exposure therapies, and exploring cultural influences on VR. Exploring a localised context is also valuable. VR as a tool to enhance PWB in a South African context needs further exploration, including plausibility, implementation, and cultural diversity. VR can be adapted to the situation and context whilst containing that psychological treatment focus. Therefore, it can be applied and personalised to many other social and cultural preferences. However, this personalisation applies to cultural preferences. It needs to maintain the goal of creating an immersive, pleasurable, calming and interactive environment, limiting personalisation to maintain treatment efficacy. This culturally sensitive yet limited personalisation attribute of VR technology can be used to investigate the possible future application of VR to increase psychological functioning in a local South African context.

Furthermore, it could be beneficial to look into possible future clinical implications of the findings, especially in relation to the South African context. The crime rate is increasing rapidly, resulting in society being left in fear [75]. The impact on the victims of crime and society at large stretches to a low quality of life and trauma-related suffering [75]. VR may be used in this new context to increase the psychological functioning of victims of crime. The unique benefits that VR treatments offer can further be clinically implemented as effective treatments for alleviating fear, anxiety and various phobias associated with treatment plans or independent from treatment plans [36]. The use of VR can further be investigated as a potential method for chronic pain management outside of hospitalisation [33]. VR technology can also be implemented as an interactive training system providing hands-on medical training experience whilst minimising the risk of real-life application [77]. These interactive training experiences can also potentially span further into a public first-aid experience that can be offered to various communities. Implementing VR technologies in healthcare systems is understudied, and concerns regarding competence training, maintenance, and intended content are prevalent. Factors such as whether implementation of VR technologies with the intended use and in the presence of regulatory and operational barriers should be considered practical implications. The importance of evaluating and validating VR technologies arises regarding content with the intended use. Scientific development of VR applications by specialised teams is essential for continuously evaluating VR applications before implementation into clinical practice [76]. With the future use of VR technologies in the clinical domain, it is also important to develop and update the related laws, standards and various guidelines to ensure the utilisation of appropriate models in the design and implementation phases [76]. Lastly, there is a need to determine appropriate policies to ensure successful implementation [76]. This spans across to ethical considerations and implications as well. As with any medical intervention, informed consent is vital; with the novelty of VR technology, it is crucial to ensure the patient fully understands the immersive and interactive nature of VR [76]. The development of VR applications should also prioritise the privacy of data and security, ensuring that patient privacy and security are sufficiently implemented [76]. This calls for a continuous ethical evaluation by ethical review boards and committees in monitoring and guiding the responsible use of VR in a clinical setting.

Before looking into future studies, it is crucial to consider the relevant limitations of this study. The novelty of VR within healthcare settings could present potential biases and underlying beliefs regarding the effectiveness of new technology compared to other treatment plans. The themes generated in this study were based on studies with various methodological qualities, various contexts,

settings, and equipment, with a focus on specific illnesses and not being inclusive of the vast array of illnesses; therefore, interpretations should be considered cautiously, especially when looking at generalisability or applicability to culturally diverse contexts.

Data availability statement

No data is available for this study as this is a review study, and no data were collected from human participants. The data were detailed in the manuscript. This declaration is outlined below.

Ethics statements and declarations

- This study was reviewed and approved by [General and Human Research Ethics Committee (GHREC) of the University of the Free State], with the approval number: [UFS-HUM-2014-68/1806/21/22].
- No data was collected from human participants as this is a critical review study. No data sets are available as only prior studies are reviewed; therefore, informed consent was not required for this study.

CRediT authorship contribution statement

Jolize du Plessis: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Jacques Jordaan:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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