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Virtual Reality in Pediatric Care

Scoping Review

MASTER`S DEGREE PROGRAMME IN WELFARE TECHNOLOGY
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ABSTRACT

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Virtual reality (VR) has increasingly been explored in healthcare as a non-pharmacological method for reducing pain, anxiety and distress. In pediatric care, VR may offer specific benefits due to children's unique developmental and emotional needs. The purpose of this scoping review is to map the existing evidence on virtual reality use in pediatric nursing, examining both clinical applications and patient-reported outcomes. The aim of this scoping review was to examine how VR was used in pediatric care, identify the clinical contexts in which it was applied and describe the reported effects and experiences from the patient perspective.

A literature search was conducted in CINAHL Ultimate and PubMed for studies published between 2015 and 2025. Studies were included if they involved children aged 0–18 years receiving a VR intervention in a healthcare setting. Data were extracted according to the PCC framework and analyzed using deductive and inductive content analysis. The review included 23 studies. VR was most commonly used during painful or anxiety-provoking procedures, such as venipuncture, burn care, fracture treatment, dental care and vaccinations. Most studies reported that VR reduced children's pain, fear and anxiety and improved cooperation and care experiences. No evidence of routine clinical implementation was identified, and no pediatric intensive care studies were found.

VR appears to be a promising method for supporting children during medical procedures, although broader adoption is limited by factors such as device costs, availability of age-appropriate content and age-related usage restrictions. The findings provide direction for further development and integration of VR into family-centred pediatric nursing practice.

Keywords: virtual reality, pediatric nursing, pediatric care, pain management, anxiety reduction, scoping review, family-centered care

CONTENTS

1 INTRODUCTION

Virtual reality (VR) technologies have rapidly gained prominence in healthcare settings over the past decade, with applications expanding from medical training to direct patient care interventions (Iqbal et al., 2024, p. 1–2). According to Iqbal et al. (2024, p. 3–7), VR is used in various clinical purposes including stress, anxiety and pain management, patient education, rehabilitation, medical training, and surgical planning and visualization.

Virtual reality can be defined as a computer-generated sensory environment designed to give the user a sense of partial or complete immersion in an artificially created reality (Cvetković, 2021). Pediatric care is a specialized healthcare field that focuses on the care of children, adolescents and their families, following the principles of family-centered care (Storvik-Sydänmaa et al., 2019, p.15). According to the *Convention on the Rights of the Child* (UNICEF UK, 1989), a child is defined as any person under the age of 18.

Children differ from adults in their developmental, psychological and emotional responses to healthcare situations. They experience fear, pain, stress and unfamiliar environments differently, and their ability to cooperate during procedures often depends on emotional regulation and supportive care strategies. Because of this, non-pharmacological interventions such as distraction, immersion and play-based methods are central in pediatric care. VR may therefore offer unique benefits for supporting children's coping, reducing fear and pain, and improving cooperation during stressful or painful procedures. (Christian, 2013.)

This scoping review addresses a critical gap in pediatric nursing literature and has important implications for clinical practice. By systematically mapping the existing evidence, this study provides healthcare professionals with a comprehensive overview of VR applications that can inform evidence-based implementation decisions. Furthermore, understanding patient-reported effects and experiences is essential for ensuring that VR interventions align with the principles of family- and patient-centered care and genuinely improve pediatric patients' healthcare experiences. The findings will also identify areas requiring further research, thereby guiding future investigations in this rapidly evolving field.

Artificial intelligence (AI)-based tools were used to support the writing process of this thesis. SciSpace and ChatGPT 5.1 were utilised for language refinement, clarification of wording, to support the verification of compliance with institutional writing guidelines and improvement of text coherence. All scientific interpretations, methodological decisions, inclusion and exclusion criteria, analyses and conclusions were made independently by the author. AI was not used for data extraction, screening or analysis of research results, and no content produced by AI was included without critical evaluation and revision. The use of AI did not influence the selection of evidence, the interpretation of findings or the conclusions of this scoping review.

2 VIRTUAL REALITY IN PEDIATRIC CARE

2.1 Virtual reality

For the purposes of this thesis, virtual reality (VR) is defined as an immersive, computer-generated environment that users experience as real through specialized devices such as head-mounted displays, motion controllers, and sensory feedback systems. This definition encompasses both the technological and experiential dimensions of VR, which is essential when examining its applications in pediatric care where both the technical functionality and the child's subjective experience are clinically relevant.

This working definition synthesizes perspectives from multiple sources. Ambrosio and Fidalgo (2020) emphasize VR's technological components, defining it as a computer-generated simulation enabling user engagement through specialized interfaces. Flores et al. (2023) focus on VR's capacity to create realistic, explorable environments, while Cvetković (2021) highlights the goal of producing credible virtual experiences that users perceive as authentic. LaValle (2023) provides broader context by connecting VR to philosophical concepts of perception and reality construction, noting that VR extends the idea that human experience is mentally constructed—a perspective that helps explain why VR interventions can effectively influence pain perception and emotional states in clinical settings.

2.2 Virtual reality in healthcare

Virtual reality has increasingly been adopted within healthcare and has demonstrated potential in several areas, including medical training, patient care, rehabilitation, and therapeutic interventions (Oyekunle et al., 2024). According to Iqbal et al. (2024, p. 1–2), VR applications in healthcare can be divided into two primary categories of use in patient care and use in medical education and training.

VR is widely used in the education and training of healthcare professionals. Ji (2024) identifies this as one of the most important current applications. VR enables physicians, nurses, and students to practice clinical skills, decision-making, and surgical procedures in a safe environment without risk to patients. It is particularly beneficial in fields such as neurosurgery, cardiology, traumatology, and other areas requiring precision and rapid responses. VR-enhanced simulations offer opportunities to practice anatomically accurate procedures, receive immediate feedback, and build confidence in clinical performance (Iqbal et al., 2024, p. 3–7; Ji, 2024; Oyekunle et al., 2024).

In patient care, VR has been used for stress, anxiety, and pain management, and in various forms of therapy and rehabilitation (Iqbal et al., 2024, p. 3–7).

Kouijzer et al. (2023) note that VR applications have been widely tested in healthcare settings, particularly in recent years. They highlight VR’s use in chronic pain treatment, post-stroke rehabilitation, treatment of depression and cancer patients, and in forensic psychiatry. VR can also be used in surgical planning and diagnosis. Even experienced professionals benefit from reduced cognitive load, improved manual skills, and increased patient safety through VR-based visualization and rehearsal of procedures. (Ji, 2024.)

In psychiatry, VR has been applied to treat post-traumatic stress disorder, support behavioural change, conduct exposure therapy, and complement psychotherapy in the treatment of phobias and eating disorders (Ji, 2024; Oyekunle et al., 2024). VR has been used to support the development of social skills in individuals on the autism spectrum and to enhance psychiatric assessment by simulating the patient’s natural environment. According to Oyekunle et al. (2024), VR technology is also utilized in child and adolescent mental health care, for example in diagnosing and treating ADHD and autism spectrum disorders. In pediatrics more generally, VR has been used in rehabilitation of cerebral palsy, management of disability-related challenges, and procedural pain management.

While VR applications have been documented across diverse healthcare populations and settings, pediatric patients present unique considerations. Children's cognitive development, emotional regulation capacities, and responses to medical environments differ substantially from adults (Storvik-Sydänmaa et al., 2019). These developmental differences suggest that VR interventions designed for adults may not be directly transferable to pediatric contexts, and that child-specific applications require careful consideration of age-appropriateness, safety, and family involvement.

2.3 Pediatric care

Pediatric care aims to provide high-quality care to children, adolescents, and their families while supporting the child’s health, growth, and development.

Depending on the source, a pediatric patient may be defined as 0–14, 0–16, or 0–18 years old, reflecting varying national and institutional practices (Comparcini et al., 2018; Christian, 2013). For this review, consistent with the UN Convention on the Rights of the Child (UNICEF UK, 1989), a pediatric patient is defined as any individual under 18 years of age.

A central principle of pediatric care is family-centered care, which emphasizes the involvement of parents or guardians and acknowledges the child as part of a family system. Pediatric nurses guide and support families in maintaining children's well-being, managing illnesses, and coping with changes in health status. Children are involved in their own care in ways appropriate to their developmental stage, and efforts are made to minimize discomfort through both conventional and complementary care interventions. (Christian, 2013.)

The history of pediatric care dates back to the 17th century, with the establishment of early children's hospitals such as Hôpital des Enfants-Malades in Paris (Etheridge, 2024). Significant milestones include the founding of Great Ormond Street Hospital in London in 1852 and St. Louis Children's Hospital in 1879 (Clarke, 2017). Florence Nightingale's emphasis on compassion and empathy in the 1860s laid an important foundation for modern pediatric care (Diogo et al., 2021). The two World Wars accelerated the development of pediatric healthcare, introducing mobile health units and antibiotics, and leading to recognition of the unique needs of children as patients (Galiana-Sánchez, 2017).

Children develop rapidly, especially in their first year of life, which poses challenges for healthcare. Some diseases are unique to childhood, and many medications used for adults cannot be safely administered to children. Children may also experience fear and pain more intensely than adults and are naturally cautious around unfamiliar people. Hospitalization can increase feelings of vulnerability and insecurity. Familiar caregivers, play, music, humor, and positive distraction techniques help support psychological safety (Storvik-Sydänmaa, 2019, p. 9, 15–16).

Children are naturally more sensitive to pain, unfamiliar people, and the stress caused by medical procedures, which makes the promotion of psychological safety an essential part of pediatric care. Children benefit from clear, developmentally appropriate explanations, opportunities to ask questions, and participation in decisions related to their care, all of which strengthen their sense of control and reduce fear. (Christian, 2013; Seniwati et al. 2023.)

Therapeutic play is an established approach in pediatric care for preparing children for procedures, supporting coping, and helping them process potentially traumatic experiences. According to Storvik-Sydänmaa et al. (2019, pp. 9, 15–16), children use coping strategies such as play, music, positive imagery and the presence of a trusted adult to manage fear and stress during medical procedures. Therapeutic play therefore forms a core component of developmentally appropriate and family-centered pediatric nursing.

Virtual reality can be conceptualized as a technological extension of these therapeutic play principles. Traditional therapeutic play relies on imagination, storytelling and interactive activities to facilitate emotional regulation and strengthen coping. VR may serve similar functions by providing an immersive and engaging environment that enhances distraction, supports a sense of control and can be adapted to a child’s developmental needs. When framed in this way, VR does not replace conventional play-based methods but complements them, aligning with the foundational principles of pediatric care (Storvik-Sydänmaa et al., 2019).

2.4 Patient and family centered care

Patient and family-centered care is a core principle of pediatric care and emphasizes the collaboration between healthcare professionals, the child, and the family. Its purpose is to promote the child’s well-being by recognizing the family as an essential part of the care environment. Pediatric care acknowledges that children depend on their parents or guardians for emotional security, decision-making, and everyday care. Therefore, care interventions must be planned and implemented together with the family, considering their resources, experiences, and concerns. (Christian, 2013.)

Family-centered care is grounded in mutual respect, open communication, and shared responsibility in the treatment process. Parents are valued as experts in their child’s behavior, needs, and coping mechanisms, and their participation strengthens both the quality of care and the child’s sense of safety. Research on pediatric care emphasizes that maintaining parental presence during procedures, providing clear information, and supporting parents’ coping skills contribute to better treatment experiences and reduced anxiety for both the child and family. (Christian, 2013; Seniwati et al. 2023; Storvik-Sydänmaa, 2019.)

For children, participation in their own care plays an important developmental and psychological role. Children benefit when they are given age-appropriate explanations and opportunities to express their feelings, ask questions, and make simple choices. This supports autonomy, reduces fear, and fosters trust in healthcare professionals. In addition, incorporating methods such as therapeutic play, preparation for procedures, and reassurance through familiar routines has been shown to alleviate distress and promote a more positive treatment experience. (Gartner et al. 2022; Seniwati et al. 2023; Storvik-Sydänmaa, 2019.)

A child’s medical situation affects the entire family, and parents’ experiences of stress, fear, and uncertainty can directly influence the child, increasing anxiety and resistance during care procedures (Gartner et al. 2022; Storvik-Sydänmaa, 2019, p. 15–16). Therefore, supporting parents, strengthening their coping abilities, and providing clear, reassuring guidance are essential for the child’s well-being. Christian (2013) emphasizes that the family is an integral part of the care team, and parental involvement and empowerment can improve the child’s cooperation, sense of safety, and overall recovery. Supporting the family is thus a key component of high-quality, family-centered pediatric care.

The principles of patient- and family-centered care also guide how virtual reality should be implemented in pediatric settings. Because VR is introduced within a relational care environment rather than used in isolation, its design and delivery must support—not replace—parental presence, participation, and communication with the child. VR interventions therefore need to be adaptable to each family's needs, allow age-appropriate preparation and explanations, and integrate smoothly into existing care routines. In addition to assessing clinical outcomes, evaluating VR use should include parents' and children's experiences, perceived support, and the extent to which the intervention strengthens the child's sense of safety. These considerations shape the focus of this scoping review, which examines VR from the perspectives of the child and family, rather than approaching it solely as a technical or procedural tool.

3 PURPOSE, AIM AND RESEARCH OBJECTIVES

The purpose of this scoping review is to map the existing evidence on virtual reality use in pediatric nursing, examining both clinical applications and patient-reported outcomes. This review aims to provide healthcare professionals, researchers, and policymakers with a comprehensive understanding of how VR is currently used in pediatric care and what effects have been documented from the patient and family perspective.

The research questions are:

- For what purposes is virtual reality used or proposed in pediatric care?
- In which healthcare situations and clinical contexts has virtual reality been applied in pediatric care?
- What kinds of effects and experiences have been reported regarding virtual reality use in pediatric care from the patient's perspective?

4 RESEARCH DESIGN AND METHODS

4.1 Scoping review

This study employs a scoping review methodology, which is well suited for mapping emerging fields where research is heterogeneous in design, terminology and outcomes (Munn et al., 2018). According to Arksey and O'Malley (2005), scoping reviews are particularly appropriate when the aim is to identify and map available evidence, clarify conceptual boundaries, examine how research has been conducted in a given field, and highlight areas where knowledge is lacking.

Virtual reality applications in healthcare have expanded rapidly in recent years across diverse clinical contexts, including chronic pain management, stroke rehabilitation, psychiatric treatment and cancer care (Kouijzer et al., 2023). Although VR is used across multiple medical specialties, the approaches, target populations and outcome measures vary considerably. In pediatric nursing specifically, no comprehensive scoping review has been conducted to describe how VR has been used, despite the unique developmental and psychosocial needs of children and their families.

A scoping review was therefore chosen for this study because VR use in pediatric care represents an emerging and methodologically diverse field, and the research questions are exploratory rather than focused on evaluating specific interventions or effect sizes. This methodology makes it possible to map the breadth of existing evidence, identify patterns across different study types and clinical settings, and highlight knowledge gaps that warrant further investigation. It also enables the inclusion of qualitative, quantitative and mixed-method studies, providing a comprehensive understanding of how VR has been applied and experienced in pediatric care.

4.2 Study protocol

For this process of data charting, this study followed the Arksey and O`Malley (2005) framework for scoping review. The study will be reported according to PRISM-SrC, Preferred Reporting Items for Systematic review and Meta-Analyses - Scoping review checklist. This is a standard for scoping review which has been created to complement the Joanna Briggs Institute (JBI) guidelines regarding reporting and the guidelines are in line with each other. (Pollock et al. 2022; Tricco et al., 2018, p.169, 467–473.)

Arksey and O'Malley`s (2005) five-step process is commonly used to guide the implementation of a scoping review. The five phases are ”identifying the research question, identifying relevant studies, selecting studies, mapping the data, and compiling, summarizing and reporting the results” (Arksey and O'Malley, 2005). Peters et al. (2024) have further defined these phases more precisely in nine phases (table 1).

Table 1. Joanna Briggs Institute framework for scoping review. (Peters et al., 2024.)

JBI framework for scoping review
1. Definition and alignment of objective(s) and questions.
2. Development of inclusion criteria and aligning them with study objectives and research questions.
3. Description of approach plan.
4. Evidence search.
5. Evidence selection.
6. Evidence extraction.
7. Evidence analysis.
8. Presentation of the results.
9. Summarizing the evidence and relating to the purpose, concluding and noting possible implications of the findings.

This scoping review followed all nine phases of the JBI framework in a systematic and transparent manner. The process began with the definition of the review purpose and scope. In the first two phases, the research questions and inclusion criteria were developed using the PCC framework (Population, Concept, Context), ensuring a clear correspondence between the objectives of the study and the criteria guiding the selection of evidence.

In the third phase, a comprehensive search plan was created. This involved selecting appropriate databases, defining search terms, and determining the use of Boolean operators, all of which were documented to facilitate reproducibility. The fourth phase consisted of conducting the evidence search, which was implemented systematically in the CINAHL Ultimate and PubMed databases in May, 2025.

The fifth phase focused on evidence selection. Screening proceeded in two stages, beginning with title and abstract review, followed by full-text assessment. Reasons for exclusion were recorded to maintain transparency throughout the selection process. In the sixth phase, data from the included studies were extracted using a standardized extraction form that captured study characteristics, VR applications, and reported outcomes.

The seventh phase involved evidence analysis, combining deductive analysis based on the PCC framework with inductive analysis to identify emerging themes within the material. In the eighth phase, the results were organized and presented using descriptive statistics, tables, and narrative synthesis structured according to the research questions.

Finally, in the ninth phase, the findings were summarized and interpreted in relation to the study purpose, and their implications for clinical practice and future research were explored.

4.3 PCC framework

The PCC framework was used to guide the development of the research questions, inclusion criteria and data extraction process, as recommended for scoping reviews by Pollock et al. (2022). PCC provides a transparent structure for identifying the key elements relevant to the review and ensures alignment between the purpose of the study and the screening process.

In this review, the Population was defined as pediatric patients aged 0–18 years. The Concept referred to the use of virtual reality as an intervention in healthcare, and the Context included clinical pediatric care settings such as hospitals, outpatient clinics and rehabilitation environments. These elements are presented in Table 2.

Table 2. PCC framework of the study. (Pollock et al. 2022.)

Population (P)	Concept (C)	Context (C)
Pediatric patients; children and adolescent 0-18 years of age.	Use of virtual reality.	Healthcare settings; hospitals, health care centres, rehabilitation units etc.

Using the PCC framework ensured that the inclusion and exclusion criteria were clearly derived from the research aim and that the evidence extraction remained focused on patient-reported or patient-relevant outcomes related to VR use in pediatric care.

4.4 Inclusion and exclusion criteria

Based on the PCC framework (table 2), the following inclusion and exclusion criteria were decided (table 3). As previously stated in chapter 2.3, pediatric care work can include children of many ages between 0-18. In this research studies that concern pediatric care and children under the age of 18 were included. Studies that had investigated also experiences of families and caregivers or professionals were included, but professional experiences were not analyzed for results. Studies regarding only virtual reality use by or for professionals are excluded from this research. This means that studies in which virtual reality is used for professional training or medical student education are excluded. Studies focusing on VR for clinical decision-making, surgical planning, diagnostic imaging, or other professional workflows were also excluded, as these do not provide patient-reported or patient-relevant outcomes.

Studies published in English or Finnish were included to ensure accurate interpretation and analysis. This language limitation is acknowledged as potentially excluding relevant research published in other languages; however, English is the predominant language of international healthcare research, and Finnish was included given the researcher's institutional context.

Studies published between 2015-2025 were included. This 10-year timeframe was selected because VR technology has evolved rapidly, with significant advances in accessibility, affordability, and clinical applications occurring within this period (Flores et al., 2023). Earlier studies may reflect outdated technology that is no longer representative of current VR capabilities. Preliminary searches confirmed that sufficient recent literature exists within this timeframe to address the research questions comprehensively.

Non-peer-reviewed articles were excluded from the research. Only studies that had full text available from open sources or available through Satakunta University of Applied Sciences library databases, were considered.

Study protocol papers were excluded because unfinished studies did not provide answers to the research questions and frequently duplicated research that was already available in completed form. Review articles were screened during the study selection process, but none were included in the final analysis. Although reviews were initially considered as potential sources for contextual understanding, they were ultimately used only to identify possible additional primary studies (snowballing), not as part of the extracted data for results.

To avoid double counting and maintain methodological consistency, only primary studies were included in the final evidence base. Review articles were therefore excluded from data extraction and synthesis, and no review findings were incorporated into the results. Their role was limited to supporting the identification of eligible primary studies during the search and screening phases, ensuring that the evidence map reflects original research rather than secondary summaries.

The search was conducted in two databases, EBSCOhost CINAHL Ultimate and PubMed. Test searches in these databases appeared to yield enough research articles and other databases were not used. To include as much material as possible, all studies that met these search term criteria were included in the study.

Table 3. Inclusion and exclusion criteria of the study.

Type of criteria	Included	Excluded
Participants	Children and adolescent age 0-18. Family and professional experiences may be included if study consider mainly children.	Participants mainly over 18 years of age. Medical students. Professionals, e.g. nurses and doctors. Expert experiences not included in results.
Concept limitations	Virtual reality in use for patient or healthcare customer care, education or rehabilitation.	Virtual reality in use for procedures or planning for them, student education or professional training.
Study design	Qualitative, quantitative and mixed primary studies.	Review articles (used only for identifying additional primary studies, not included in the results). Duplicate articles appearing in reviews.
Publication characteristics	Peer-reviewed articles. Free full text available with or without SAMK-ID. Published 1.6.2015-30.5.2025. In English or Finnish.	Non-peer-reviewed articles. No free full text available with or without SAMK-ID. Published before 30.5.2015. Other language than English or Finnish.
Resource	Published at EBSCO-host or PubMed database.	Published in other databases.

4.5 Search strategy

The search strategy was developed through an iterative process. Initial pilot searches were conducted in May 2025. CINAHL Ultimate and PubMed were selected as the primary databases because: (1) CINAHL is the leading nursing and allied health database, ensuring comprehensive coverage of nursing literature; (2) PubMed provides extensive coverage of biomedical and clinical research; and (3) preliminary searches indicated that these databases yielded substantial relevant results with significant overlap, suggesting saturation of available evidence. Additional databases (e.g., Embase, PsycINFO) were considered but not included as pilot searches showed minimal additional unique results beyond those captured in CINAHL and PubMed.

Database selection in scoping reviews must be appropriate to the topic and justified in relation to feasibility, scope, and research aims rather than maximized without rationale (Arksey & O’Malley, 2005; Peters et al., 2024). Reference list screening, recommended by JBI, was also performed, but no additional eligible full-text studies were found (Peters et al., 2024).

Used search words (table 4) were: ("virtual reality" OR VR) AND (pediatric OR child OR children OR adolescent) AND (care OR healthcare). These terms were selected to ensure alignment with the PCC framework and to capture VR interventions used directly with pediatric patients in clinical care contexts. Broader terms such as “pain”, “anxiety”, “procedure”, “therapy”, or “play” were intentionally not included, as pilot searches showed that they generated very high proportions of irrelevant records (e.g., adult rehabilitation, engineering, mental health therapy, surgical simulation).

Table 4. Key terms used in database search.

Database	Key terms
PubMed	(VR OR "virtual reality") AND (pediatric or child or children or infant or adolescent) AND (care OR healthcare) NOT (study protocol)
CINAHL/EBSCOhost	(VR OR (virtual reality)) AND (pediatric or child or children or infant or adolescent) AND (care OR healthcare) NOT (study protocol)

Studies that don’t apply to care work are excluded from the results. Augmented reality (AR) was not included as a primary search term because the focus of the review was on virtual reality technologies and the use of immersive digital environments in pediatric care. Including *“augmented reality”* as a keyword in trial searches yielded large numbers of studies unrelated to care (e.g., surgical navigation, radiology, operating room guidance, industrial applications), which would have reduced the specificity of the search. However, AR studies that emerged from the database search were not excluded automatically. Consistent with PRISMA-ScR and JBI recommendations, scoping reviews should remain inclusive when technologies are conceptually adjacent to the phenomenon of interest. (Tricco et al., 2018; Peters et al., 2024.)

AR interventions were therefore included only when they were used *with pediatric patients*, and they were part of *clinical care* or affected the pediatric patient experience. This ensures conceptual coherence without restricting potentially relevant evidence. (Tricco et al., 2018; Peters et al., 2024.) When narrowing search criteria, care must be taken to ensure that the material is sufficiently representative and that the material is not too limited in advance (Beck & Polit, 2017, p. 160-172, 249-252).

4.5.1 Study selection

According to good scientific practice, which guides the ethical starting points of research in Finnish research, researchers must observe "honesty, general care and accuracy in research work, in recording and presenting results, and in evaluating studies and their results". When making research defining information retrieval or studies to be included, the defining made visible in the final report of the research is written openly. (Varantola et al. 2012, p.30-31.)

Study selection process was executed simultaneously with the research process. PRISMA.org flow diagram (figure 1) is used to visualize the search process. This diagram follows the PRISMA guidelines (Tricco et al. 2018). The search was performed in two sessions, and the final search was conducted 31.5.2025 and no later searches were made to the databases.

Overall, N = 2430 studies were found. After applying definition of publication characteristics, study quantity was reduced to N = 285 and after duplicate removal to N = 203. Results were then divided to primary studies (N = 127) and reviews (N = 76). Both categories were screened manually at title level and N = 112 studies were removed.

At this point, studies were exported to Mendeley reference manager for easier access. Studies were manually screened again at abstract level and based on the eligibility criteria (table 3), Forty two (N = 42) studies were excluded from the results. Full text review was performed on forty nine (N = 47) studies of which twenty nine (N = 23) primary studies were included in the final analysis. Figure 1 shows the reasons for exclusion for eighteen (N = 18) studies. Data from individual studies included in the systematic reviews were not double counted in the analysis.

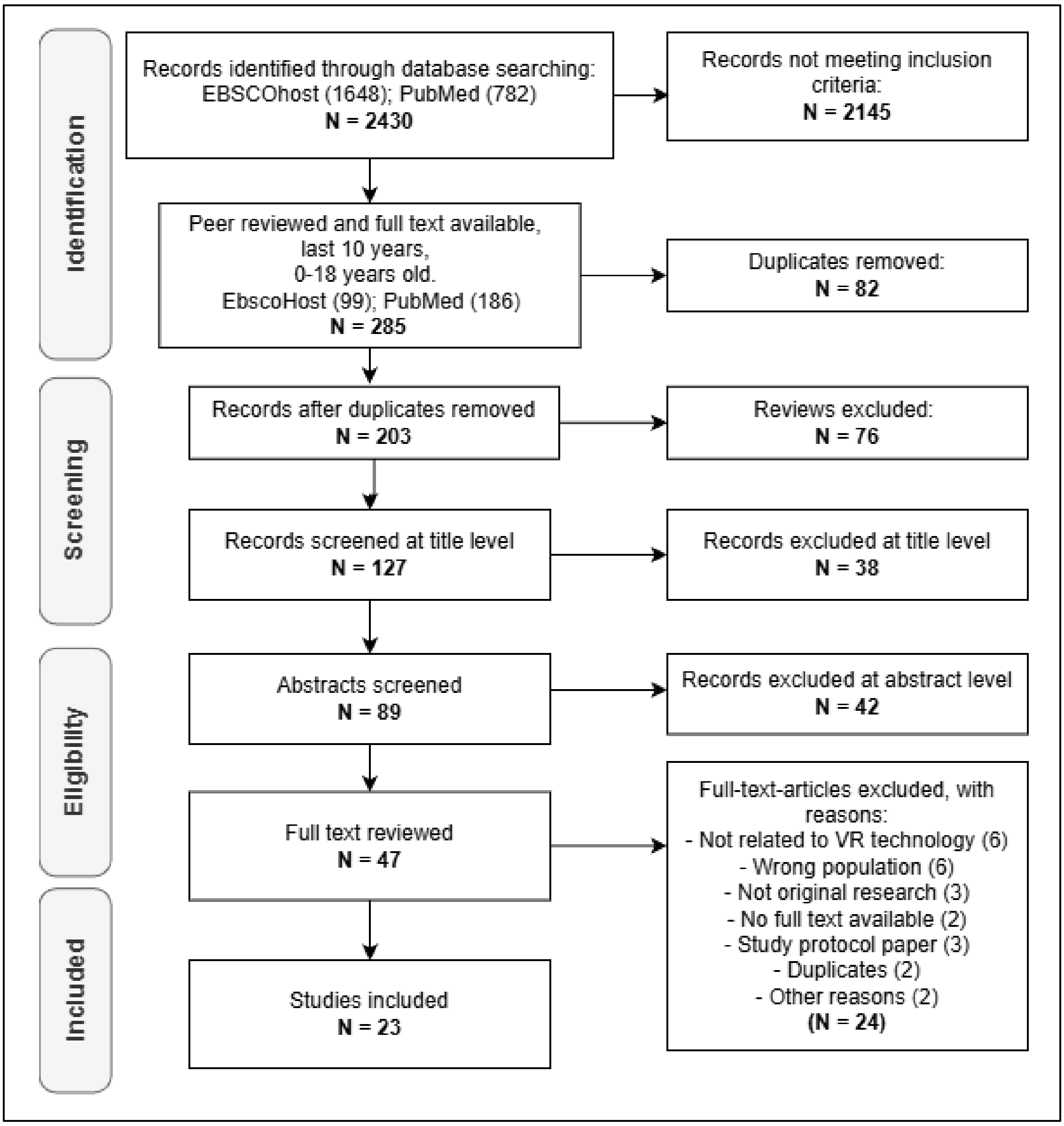

Figure 1. PRISMA-ScR flow diagram on study selection.

4.5.2 Critical appraisal

Mun et al. (2018) has stated that critical appraisal is usually not done with scoping review. However, the results were critically reviewed throughout the process to ensure reliability. Inclusion criteria acted as the methodological filter (Beck & Polit, 2017, p.160–172). Quality appraisal tools were not used because scoping reviews aim to map evidence rather than evaluate the methodological quality of individual studies, consistent with JBI guidance (Peters et al., 2024).

4.6 Data extraction, analysis and data synthesis

Data extraction was conducted systematically using a standardized form developed specifically for this review. The following information was extracted from each included study (Table 5.) Data extraction was performed by single reviewer.

Table 5. Extracted information from research data.

Extracted information
• Article name
• Author(s), publishing year
• Study design and method, sample size
• Clinical setting
• Age of participants
• Purpose of use of VR
• Is the application currently in use
• Device
• Software content
• Interaction level
• Results; reported effects and patient and family experiences
• Adverse events or limitations
• Other considerations

In this research the data was analysed using basic qualitative content analysis method in a deductive-inductive manner. The progress of the analysis is shown in figure 2.

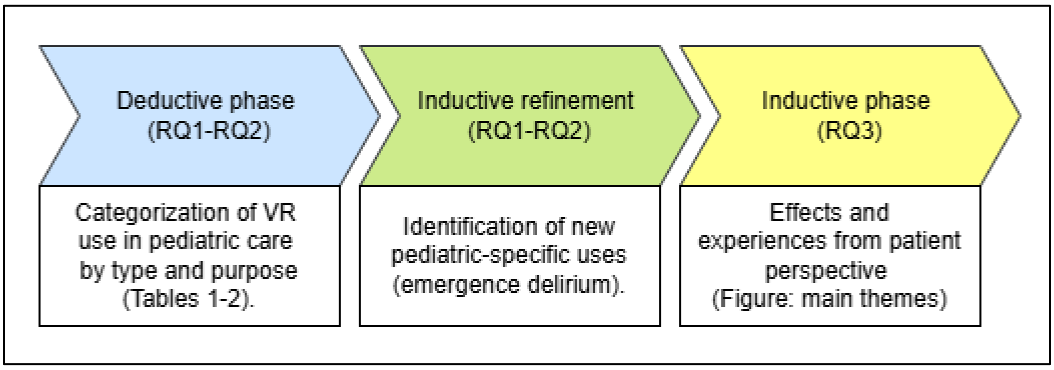

Figure 2. The progress of the analysis.

Basic qualitative content analysis is well suitable for scoping reviews and is recommended e.g. by Joana Bricks Institute (Peters et al. 2020). Elo and Kyngäs (2008, p.109) state that this is due to it´s descriptive and systematic structure for presenting themes emerging from data. Their four stages—preparation, organization, reporting, and abstraction—can be adapted to scoping reviews, with the abstraction phase omitted (Pollock et al., 2022).

The starting point of content analysis is to classify text into smaller and simpler content categories, making it easier to create connections between articles. Content category may be some theme or even only a word. It should, however, strive to answer the research question. (Elo & Kyngäs, 2008, p.109.)

4.6.1 Deductive phase

The deductive analysis was based on categories of VR usage identified from previous literature (Iqbal et al., 2024, p.3-7). Iqbal et al. have studied the use of different virtual reality applications in healthcare on their research (figure 3). They presented two main categories of medical education and training, and patient care. For patient care they presented seven subcategories; telemedicine, radiology, medical imaging and visualization, multifaceted pain management, ICU, rehabilitation and after intensive care, invasive procedures (professional use in surgery) and alleviating stress and anxiety. Medical education and training was divided to augmented reality in medical education and training enhancements.

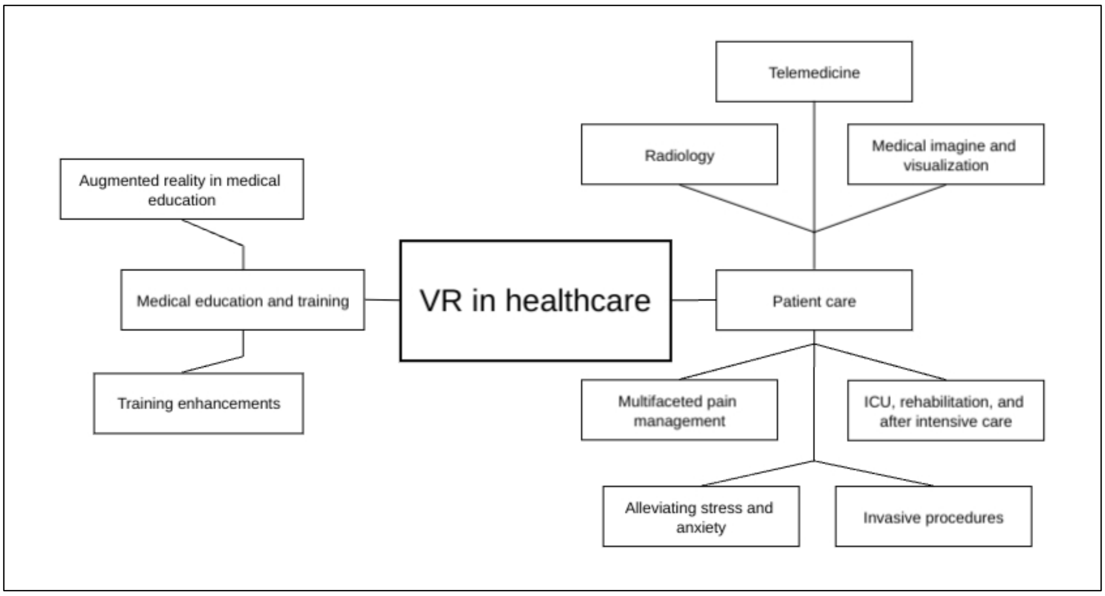

Figure 3. Virtual reality implementation areas in healthcare according to Iqbal et al. (2024, p.3-7.)

For this review, only categories relevant to pediatric care and the *patient perspective* were retained. Consequently, categories such as medical education and training, telemedicine, radiology and, medical imagine and visualization were excluded from further analysis since they fall outside the scope of pediatric care and the patient-centered perspective adopted in this review.

4.6.2 Inductive phase 1

As analysis progressed, new uses specific to pediatric care were identified that did not fit existing categories. Since the scoping review aims to create a broad map of phenomenon, the deductive analysis was expanded with inductive analysis refinements as suggested by Elo and Kyngäs (2008, p.111-112). Rather than imposing predetermined categories, this phase allowed themes to emerge from the data itself.

Inductive analysis involves open coding, categorization, and abstraction. First, the material was read through, taking notes and writing headings on the results. The second step on inductive analysis is to categorize the headings found in the text by making comparisons and combining, that describe the same phenomenon. (Elo & Kyngäs 2022, p.109-111.) Extracted data on VR purposes and applications were reviewed line-by-line, and similar applications were grouped together. Articles were read as many times as needed to ensure that all details were noted.

Through an iterative process of reading, coding, and categorizing, distinct themes emerged regarding how VR is used in pediatric care. These themes were refined through constant comparison until a coherent classification system was established that captured the diversity of VR applications reported in the literature.

Finally, the findings were reflected in the framework of patient- and family-centered care. The results were presented in a table format, describing the uses and care situations of VR, as well as the types of applications and example studies related to these (table 7). (Pollock et al. 2022).

4.6.3 Inductive phase 2

A second inductive analysis focused specifically on the measured and patient-reported outcomes and on children's and families' experiences with VR in pediatric care. All data segments describing effects, emotional or bodily experiences, perceptions, satisfaction, or interactional aspects of care were extracted and coded.

The coding process followed iterative inductive content analysis principles: similar meaning units were grouped, compared, and refined to identify recurring patterns across studies. Attention was given to the child's and family's perspectives in line with family-centered care principles, emphasizing how VR influenced emotional responses, cooperation, and the overall care experience.

Subthemes were then organized into broader main categories to form a coherent thematic structure. The final categories are presented visually in Figure 5 in results. Frequency counts (n) indicate how many studies contributed to each subtheme. Because individual studies often reported multiple effects, a single study could be represented in several subthemes, and total counts therefore exceed the number of included studies.

4.7 Ethical considerations

This thesis followed the principles of good scientific practice as defined by the Finnish National Board on Research Integrity (2023). These principles include honesty, accuracy, and diligence at all stages of the research process, as well as responsible and transparent reporting of research results. The research was designed and conducted in accordance with ethically sound and methodologically sound practices (Polit & Beck, 2017, p.675-686), and previous research was cited accurately and respectfully (Satakunta University of Applied Sciences, 2023).

As this study is a scoping review, no personal data were collected and no interventions involving human participants were conducted. Therefore, the research did not require ethical approval or formal research permissions. The handling of data and the presentation of results were performed in a transparent and responsible manner, consistent with the standards of scientific reporting. (Peters, et al., 2024).

Ethical responsibility also includes recognising and declaring potential conflicts of interest and other relevant affiliations (Polit & Beck, 2017, p.675-686). This study had no external funding or competing interests that could have influenced the research process or interpretation of findings.

5 RESULTS

5.1 Overview of the included studies

A total of 23 studies were included in the review, representing research conducted between 2018 and 2025 across various countries and clinical contexts. Most studies originated from the United States, Canada, Turkey, Germany, the Netherlands, China, and Spain, covering a broad range of pediatric healthcare environments such as emergency departments, outpatient clinics, burn units, oncology wards, primary care centres, and perioperative settings. A detailed table of all included studies, including study characteristics and VR applications, is provided in Appendix 1.

Across the studies, virtual reality was used primarily during painful or stressful procedures, most commonly venipunctures, intravenous cannulation, catheter insertions, burn wound care, fracture treatment, and vaccination. Several studies also examined VR use in surgical preparation, chemotherapy-related fatigue, dental anxiety management, and elective surgery induction. The included studies involved children from early childhood to late adolescence (approximately ages 2 months to 18 years), although many VR headset manufacturers officially recommend use from around age 12 or 13.

The majority of studied employed quantitative intervention designs, particularly randomized controlled trials, crossover trials and other prospective or quasi-experimental designs, complemented by a smaller number of pilot feasibility, mixed-methods and validation studies. Sample sizes varied widely, from small pilot trials with around 15–20 participants to larger multicentered studies including up to 300 children.

VR interventions differed considerably in both technological implementation and level of interactivity. Head-mounted devices such as Oculus, Pico, Google Daydream, and smartphone-based headsets were the most commonly used. Semi-immersive projector-based dome environments were studied especially with very young children during burn care. The software content included interactive VR games, breathing-based biofeedback applications, guided mindfulness or hypnosis programs, and immersive 360-degree videos. The level of interactivity ranged from fully interactive games controlled by head movements or biofeedback to passive non-interactive videos used solely for visual distraction.

Most studies compared VR to standard care or alternative distraction methods such as tablet videos, kaleidoscopes, music, or parental presence. The primary outcomes measured across studies included pain, anxiety, fear, distress, procedural cooperation, emergence delirium, and patient satisfaction. Pain was commonly assessed using scales such as Faces Pain Scale-Revised (FPS-R), Visual Analogue Scale (VAS), Face, Legs, Activity, Cry, Consolability scale (FLACC) or Numerical Pain Rating Scale (NPRS), while anxiety and fear were measured with validated pediatric scales.

Overall, the included studies reflect an expanding but still emerging field of research. VR was generally well tolerated, with adverse effects being rare and typically mild (Chan et al., 2019; van den Berg et al., 2023). However, many studies reported practical challenges such as headset size for young children, time requirements for staff, and variability in children's engagement with the content. Sample sizes were often small (Flores et al., 2023; Huang et al., 2025; Kouijzer et al., 2023; Trusculescu et al., 2025; Wong & Choi, 2023; Xiang et al., 2021), and protocols were tightly controlled, which may limit generalizability.

Importantly, the literature search did not identify information on whether VR interventions are already actively used in routine pediatric care practice. Most studies investigated experimental, pilot, or potential uses of VR facilitated by research staff or clinicians during the study period, rather than describing established everyday implementation in clinical care workflows. Based on the included studies, it is not possible to say how many VR applications are already in use.

5.2 Use and clinical applications of virtual reality in pediatric care

In the first phase of the analysis, the data were examined deductively and categorized according to the categories identified in previous literature on the use of VR in healthcare (Table 6) (Iqbal et al., 2024, p. 3–7). Only the categories relevant to pediatric care and the patient's perspective were retained, and the analysis focused on identifying the uses, clinical applications, and clinical contexts of VR in pediatric care. In the present study, categories related to medical education and training, as well as the patient care subcategories of telemedicine, radiology, and medical imaging and visualization, were excluded as they were not relevant to the research questions. Therefore, only the categories "multifaceted pain management," "alleviating stress and anxiety," and "ICU, rehabilitation, and after intensive care" were considered (Figure 4).

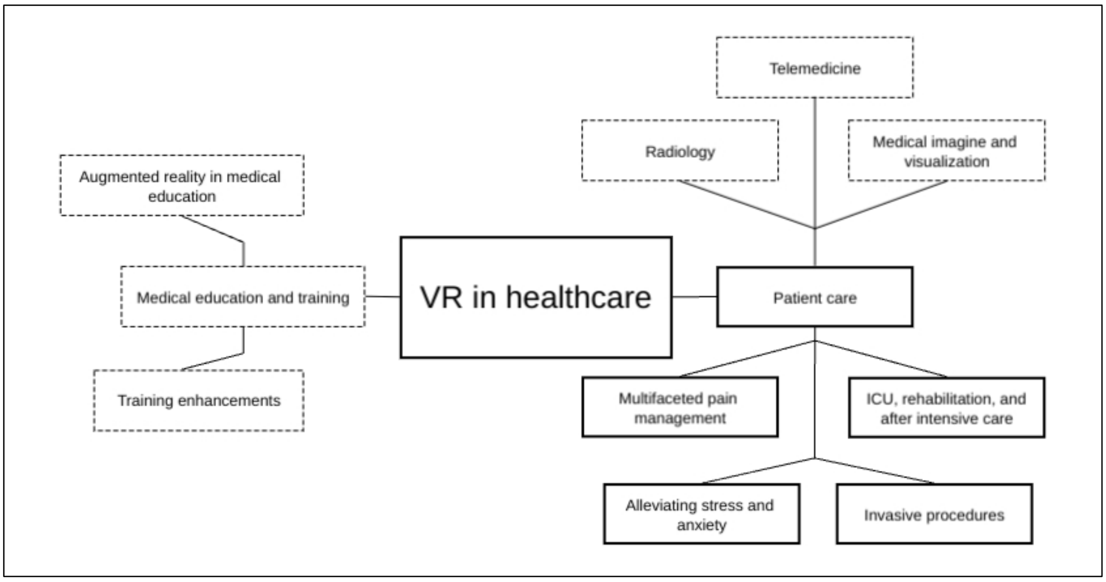

Figure 4. Virtual reality implementation areas relative in pediatric care (Iqbal et al. 2024, p.3-7).

Table 6. VR use in pediatric care and their clinical applications. Deductive categories adapted from previous literature.

Category of VR use	Clinical applications in pediatric care	Description (clinical context / purpose)	n	Example references	Type of analysis
Multi-faceted pain management	Acute care in ER; burn treatments; treatment of fractures; vaccination; invasive procedures (PIC placement, venipunctures, transurethral catheters, surgical dressing change, port puncture, lumbar puncture/bone marrow puncture, Broviac catheter placement).	Redirecting the child's attention to a pain-relieving VR environment to reduce pain during and after procedures and operation.	***15***	Butt et al., 2021; Diaz-Hennessey et al., 2019; Le May et al., 2021; Herrera et al., 2025; Savas et al., 2024	Deductive
Alleviating stress and anxiety	Fatigue management training during chemotherapy; treatment of fractures; preparation for procedures and surgery; vaccination; invasive procedures (PIC placement, venipunctures, port puncture, lumbar puncture/bone marrow puncture, Broviac catheter placement); dental care.	Redirecting the child's attention to calming or inspiring VR environment to reduce fear and anxiety before and during procedures and operations; and distraction through play.	***16***	Gerçeker et al., 2024; Le May et al., 2021; Huang et al., 2025; Herrera et al., 2025; van den Berg et al., 2023; Trusculescu et al., 2025	Deductive
ICU, rehabilitation, and after intensive care	Intensive Care.	Creating a calm, life-like environment to enhance physical activity and enhance rehabilitation.	***0***		Deductive
Alleviating emergence delirium	Elective surgery preparations.	Redirecting the child´s attention away from upcoming surgery to alleviate post-operational emergence delirium.	***1***	Chen et al., 2022	Inductive

A considerable proportion of the included studies (n = 15) examined the use of VR for pain management in pediatric care (e.g. Butt et al., 2021; Savas et al., 2024). VR was used particularly in acute and procedural settings (e.g. Schlechter et al., 2020), in burn dressing changes (e.g. Le May et al., 2021), burn wound care (Khadra et al., 2020), fracture treatment (Fabricant et al., 2023), and various invasive procedures such as venipunctures, peripheral intravenous catheterization, and port punctures (e.g. Aydos et al., 2024; Caruso et al., 2019; Reitze et al., 2024). VR was also utilized during vaccinations (Herrera et al., 2025) and in emergency room settings (Goktas & Avci, 2023). Across these studies, VR was commonly used as a distraction method, and results consistently demonstrated reductions in perceived procedural pain (e.g. Le May et al., 2021).

Another frequently identified purpose of VR (n = 16) related to reducing stress and anxiety before or during clinical procedures (e.g. van den Berg et al., 2023; Gerards et al., 2025). These applications included surgical preparation (Huang et al., 2025), invasive procedures such as peripheral intravenous catheter insertion (Goldman & Behboudi, 2021), chemotherapy-related anxiety (Gerçeker et al., 2024), and dental treatment (Trusculescu et al., 2025). Calming or interactive VR environments were reported to help children feel more relaxed, less fearful in medical settings, and more cooperative during procedures (e.g. Butt et al., 2022; Schlechter et al., 2021).

Based on the included studies, this scoping review did not reveal evidence of VR being used in intensive care or post–intensive care rehabilitation within pediatric care contexts.

During the analysis, a new application of VR in pediatric care was identified that had not been recognized in previous literature: the use of VR to alleviate post-operative emergence delirium. One study implemented VR during perioperative preparation and reported significantly reduced post-operative emergence delirium among children (Chen et al., 2022). This expands the framework by Iqbal et al. (2024) by introducing a novel, pediatric-specific application.

Although the predefined categorization (Table 6.) based on previous literature provided an initial framework for identifying the main purposes of VR use, it did not fully capture the diversity of clinical contexts or provided a sufficiently in-depth answer to RQ2. Therefore, a more detailed categorization was developed based on the type of VR intervention, clinical situation, and reported main objectives. Grouping the studies by the form and delivery of VR—such as interactive games, passive immersive videos, and calming or educational environments—enabled a more precise examination of how different types of interventions were applied in various pediatric care situations and for different purposes. This type-based categorization also clarified the relationship between VR modality, clinical context, and patient-reported outcomes, thereby supporting the analysis of RQ1 and RQ2. A detailed type-based categorization of VR use in pediatric care is presented in table 7, describing the clinical situations, purposes, number of studies, and example references.

Table 7. Types of virtual reality (VR) interventions identified in pediatric care, their clinical contexts, purposes, and main reported aims.

Type of VR intervention	Clinical situation / Setting	Purpose / Category of VR use	Main reported objective	n	References
Cognitive or behavioral VR interventions (head-mounted displays)	Acute care, emergency room; venipuncture.	Minfulness excescises; Virtual Reality Hypnosis.	To enhance calmnes, reduce anxiety and pain.	*3*	Savas et al., 2024; Butt et al., 2021; van den Berg et al., 2023
	Pre-procedural anxiety management.	Emotional regulation and distraction through breathing control (biofeedback-based).	To reduce fear and enhance calmness.	*1*	Aydos et al., 2024
	Chemotherapy.	Minfulness excescises.	To enhance calmnes and reduce anxiety.	*1*	Gerçeker et al. 2024
Interactive VR games (immersive VR experiences /head-mounted displays)	Emergency room, acute care; Treatment of fractures.	Pain and anxiety management.	To reduce pain and anxiety.	*2*	Diaz-Hennessey et al., 2019; Fabricant et al., 2023
	Burn care.	Pain, anxiety and fear management.	To reduce pain, anxiety and fear.	*2*	Xiang et al., 2021; Le May et al., 2021
	Painful or stressful procedures (e.g. venipuncture, phlebotomy, port access).	Pain management of oncology patients.	To reduce pain of oncology patients.	*1*	Caruso et al., 2019
	Elective surgery waiting room.	Distraction and pain management.	To reduce post-operational pain and emergence delirium.	*1*	Huang et al., 2025
Interactive VR games (semi-immersive / projected environment)	Burn care.	Pain management.	To reduce pain.	*1*	Khadra et al., 2020
	Venipuncture.	Distraction and pain management.	To reduce pain, anxiety and distress.	*3*	Schlechter et al., 2020; Chan et al., 2019; Piskorz & Czub, 2018
Immersive calming or nature-themed VR environments	Dental procedures.	Anxiety and stress management.	To reduce anxiety and stress.	*1*	Trusculescu et al. 2025
	Burn care.	Distraction and pain management.	To reduce pain, anxiety and fear.	*1*	Xiang et al., 2021

Type of VR intervention	Clinical situation / Setting	Purpose / Category of VR use	Main reported objective	n	References
Passive immersive VR videos	Painful or stress-ful procedures (e.g. venipuncture, port access, lumbar puncture, bone marrow aspiration, Broviac use).	Pain, anxiety and medical fear management.	To reduce pain, anxiety, medical fear and distress.	***4***	Gerards et al., 2025; Goktas & Avci, 2023; Reitze et al., 2024; Goldman & Behboudi, 2021
	Elective surgery waiting room and induction.	Distraction and pain management.	To reduce emer-gence delirium and post-operational pain.	***1***	Chen et al., 2022
	Dental procedures.	Anxiety and stress management.	To reduce anxiety and stress.	***1***	Trusculescu et al. 2025
Educational or preparatory VR simulations	Elective surgery waiting room and induction.	Distraction and emotional preparation for sur-gery.	To reduce pre-operational fear and anxiety.	***1***	Gold et al., 2021
	Vaccination.	Distraction and pain management.	To reduce pain and anxiety related to vaccination.	***1***	Herrera et al., 2025

The most common virtual reality interventions were interactive VR games, which were used in a total of ten *(n = 10)* studies. Interactive games were classified into two categories in the present study: immersive VR experiences with head-mounted displays (e.g. Huang et al., 2025) and semi-immersive or projected VR environments (e.g. Khadra et al., 2020). Games in projected en-vironment were mainly studied in small children for burn treatment (Khadra et al., 2020) while semi-immersive games were used in three *(n = 3)* studies as a distraction method and for pain management during venipuncture (e.g. Chan et al., 2019; Schlechter et al., 2020). Interactive VR games with immersive experience were applied in six *(n = 6)* studies to reduce pain, anxiety and fear (e.g. Caruso et al., 2019; Fabricant et al., 2023; Xiang et al., 2021), and as distraction method (Huang et al., 2025). These interventions were studied in the treatment of burns (Xiang et al., 2021; Le May et al., 2021), during painful and stressful procedures (Caruso et al., 2019), in emergency care (Diaz-Hen-nessey et al., 2019; Fabricant et al., 2023), and in one study while waiting for elective surgery (Huang et al., 2025). One study reported conflicting findings; certain research groups concluded that less immersive distraction method were sufficient and found no additional benefit of using VR (Goktas & Avci, 2023).

The second most frequently used intervention was passive immersive VR videos. They were most commonly used to distract patients in painful and stressful situations such as venipunctures, lumbar punctures, and other catheter insertions (e.g. Gerards et al., 2025; Goktas & Avci, 2023). They were also applied during elective surgery preparation (Chen et al., 2022) and dental procedures (Trusculescu et al. 2025). Passive immersive VR was reported to reduce pain, anxiety, and fear (e.g. Gerards et al., 2025; Reitze et al., 2024, Trusculescu et al. 2025). Among children preparing for surgery, passive VR was also associated with reduced post-operative emergence delirium and lower pain levels (Chen et al., 2022).

Cognitive or behavioural VR interventions using head-mounted displays (n = 5) formed another category. These included mindfulness and breathing exercises, VR-guided yoga and virtual reality hypnosis (e.g. Aydos et al., 2024, Gerçeker et al. 2024; Savas et al., 2024). Such interventions were applied in acute care and venipuncture (e.g. Butt et al., 2021; van den Berg et al., 2023), in preparation for procedures (Aydos et al., 2024), and to reduce chemotherapy-related nausea and fatigue (Gerçeker et al. 2024). These VR-assisted activities were reported to reduce anxiety, fear and pain (e.g. Savas et al., 2024), and to increase patients` calmness during procedures (e.g. Aydos et al., 2024).

Educational or preparatory VR simulation and immersive calming or nature-themed environments were the least commonly studied interventions. An educational VR simulation game was used during elective surgery waiting room and during induction in the operating theatre, used both as a distraction method and for emotional preparation for upcoming operation (Gold et al., 2021). An immersive educational experience was applied during vaccinations and was found to be effective in reducing pain and anxiety (Herrera et al., 2025). Nature-themed and calming environments were applied to reduce anxiety, stress, and pain with burn treatment (Xiang et al., 2021), and to provide distraction in dental procedures (Trusculescu et al. 2025). Overall, these interventions were reported to have positive effects on patient comfort and emotional well-being.

5.3 Reported effects and experiences of VR use from the patient's perspective

The third research question (RQ3) focused on identifying the reported effects of VR use in pediatric care from the patient's perspective. An inductive content analysis was performed, which resulted in several subcategories from which four main categories were formed (Figure 4). These main categories were *emotional regulation and well-being*, *pain and discomfort management*, *cooperation and efficiency in care procedures*, and *care experience and the family perspective*.

Twenty studies (n = 20) reported effects classified under the category *pain and discomfort management*. Sixteen studies (n = 16) reported results within *emotional regulation and well-being*. Fewer studies reported findings in the categories of *cooperation and efficiency in care procedures* (n = 7) and *care experience and the family perspective* (n = 5). As one study could contribute to multiple subthemes, the totals exceed the number of included studies. Figure 5 illustrates how individual subcategories clustered into these four main thematic domains.

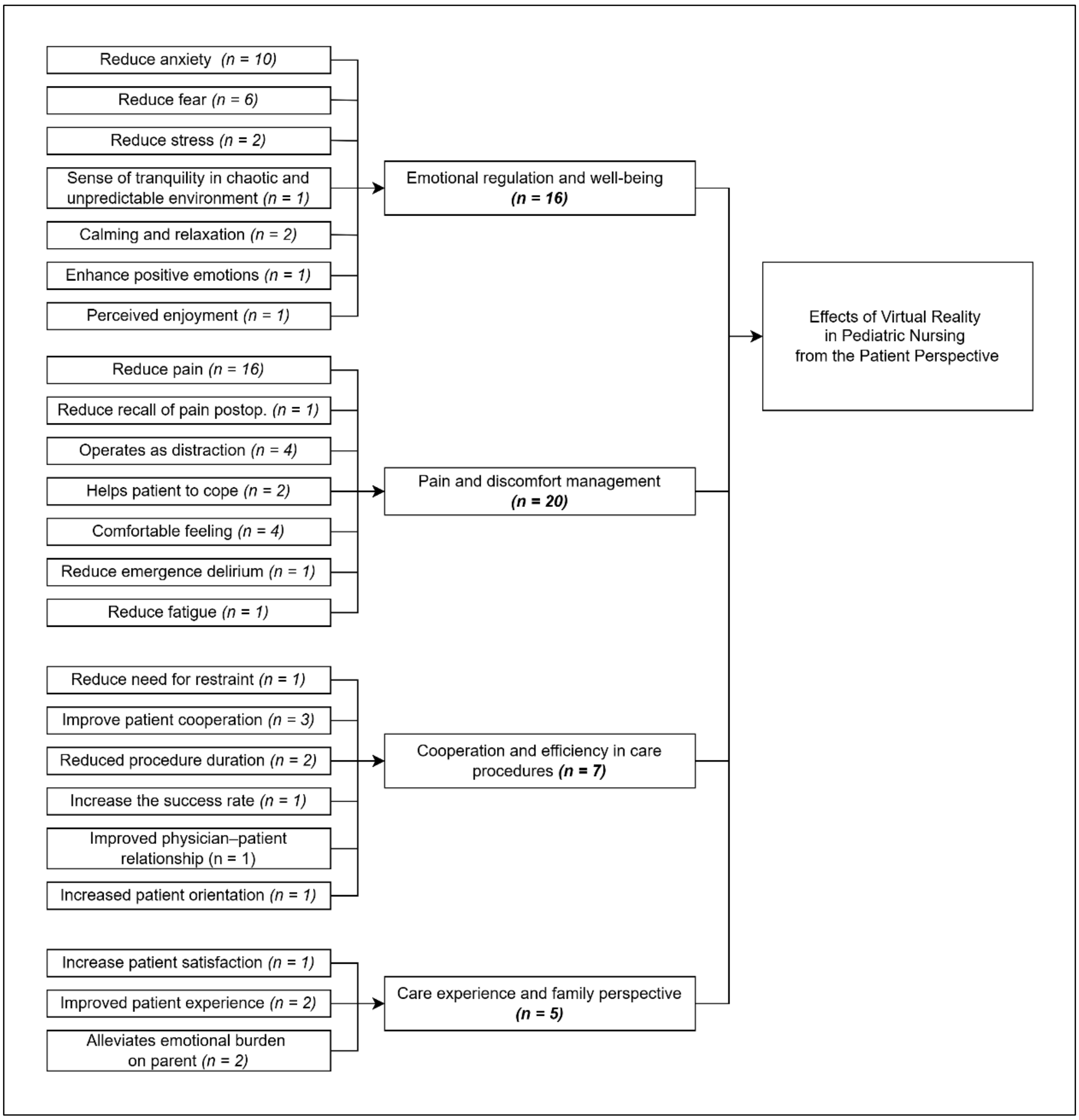

Figure 5. Inductive content analysis illustrating the effects of virtual reality in pediatric care from the patient perspective.

5.3.1 Emotional regulation and well-being

The category of *emotional regulation and well-being* includes the reported effects of VR related to reducing anxiety, fear and stress, and promoting calmness and positive emotions. A total of 16 studies (n = 16) reported outcomes within this category, most commonly during invasive procedures such as venipunctures, burn care, and emergency room treatment situations.

VR was largely reported to reduce anxiety and stress levels (e.g. Butt et al., 2021; Gerçeker et al. 2024; Reitze et al., 2024), alleviate children's fear of medical procedures (e.g. Aydos et al., 2022; Gold et al., 2021), and helped them relax and shift attention away from the upcoming intervention (e.g. Gold et al., 2021; Reitze et al., 2024; Trusculescu et al., 2025). Several studies reported decreased amount of anxiety-related behaviours such as crying, muscle tension or elevated pulse rate (e.g. Khadra et al., 2020; van den Berg et al., 2023; Wong & Choi, 2023). Some studies demonstrated significantly lower self-rated anxiety levels during iv insertions compared to standard of care (e.g. Goldman & Behboudi, 2021). Others reported significantly lower mean fear scores during and after procedures such as port catheter insertion (e.g. Savas et al., 2024).

However, a few studies found no clear benefits of VR over other commonly used distraction methods, such as parental presence or watching videos on a tablet (e.g. Goktas & Avci, 2023). Although VR was not consistently superior across all studies, the majority reported meaningful reductions in anxiety, fear, and stress across various pediatric care situations.

5.3.2 Pain and discomfort management

Twenty studies (n = 20) reported results which were classified into the category of *pain and discomfort management,* in pediatric care. This category describes the reported effects of VR related to reducing procedural pain (e.g. Chan et al., 2018; Fabricant et al., 2023; Le May et al., 2021), fatigue (e.g. Gerçeker et al., 2024), and in some cases, post-operative emergence delirium (e.g. Chen et al., 2022), as well as easing children's distress by diverting attention away from painful procedures (e.g. Herrera et al., 2025; Piskorz & Czub, 2018; Savas et al., 2024). These outcomes were frequently observed during emergency care and painful or invasive procedures such as fracture treatment, venipuncture, vaccination, lumbar puncture, burn care, and insertion of various catheters.

VR interventions were consistently reported to reduce both measured pain (e.g. Reitze et al., 2024) and self-reported pain levels (e.g. Herrera et al., 2025; Savas et al., 2024) during and after painful procedures such as venipunctures and catheter insertions. Several studies also noted improved procedural tolerance among children (e.g. Xiang et al. 2021). For example, the level of worst pain experienced during burn treatment was significantly lower with interactive VR distraction compared to control groups (Xiang et al., 2021).

5.3.3 Cooperation and efficiency in care procedures

The category “cooperation and efficiency in care procedures” included findings from seven studies (n = 7). Improvements in cooperation were commonly reported in studies where VR reduced anxiety or procedural distress (e.g. Gold et al., 2021; Huang et al., 2025). Reported effects included reduced need for physical restraint (Chan et al., 2019), improved child cooperation (e.g. Butt et al., 2022; Schlechter et al., 2021), smoother interaction between children and healthcare professionals (e.g. Butt et al., 2022), and shorter procedure duration (Wong & Choi, 2023).

5.3.4 Care experience and the family perspective

The category “care experience and the family perspective” included findings from five studies (n = 5). Reported effects included reduced emotional burden on parents, improved overall care experience for children, and higher levels of patient satisfaction (e.g. Caruso et al., 2020; van den Berg et al., 2023). These effects were typically linked to children appearing calmer, more engaged, or more comfortable during care, which in turn shaped how families perceived the care encounter.

Overall, the findings indicate that virtual reality is most widely applied in pediatric care as a non-pharmacological method to reduce pain, anxiety, fear, and procedural distress. While the effectiveness varied across interventions and clinical situations, most studies reported positive outcomes from the patient perspective. The evidence suggests that VR may also enhance cooperation during procedures and improve overall care experiences for both children and families. However, the research remains concentrated on pilot and experimental applications, and little is known about the routine clinical use of VR in pediatric care. These findings form the basis for discussing the potential role, benefits, and limitations of VR in pediatric care in the following section.

6 DISCUSSION

6.1 Comparison with previous research

The results revealed four key areas of impact: pain and discomfort relief; anxiety and fear reduction; improved cooperation and procedural smoothness; and the overall care experience including the family's perspective. The effects were most consistent for pain relief (e.g. Fabricant et al., 2024; Le May et al., 2021; Xiang et al., 2021). In contrast, the findings related to anxiety reduction were more variable (e.g. Goktas & Avci, 2023; Goldman & Behboudi, 2021; van den Berg, 2023). This variability may relate to differences in study design and contextual factors, such as the child's developmental stage, the quality and level of immersion of the VR content, the presence of a parent, and the perceived safety of the care environment. These factors are central components of pediatric care theory and are known to influence the child's emotional regulation and coping during healthcare procedures (Christian, 2013; Storvik-Sydänmaa, 2019).

VR applications in the included studies were predominantly concentrated in acute, short-term procedures such as blood sampling and cannulation (e.g. Chan et al., 2019; Reitze et al., 2024), burn care (e.g. Khadra et al., 2020), fracture management (Fabricant et al., 2024), vaccinations (Herrera et al., 2025), and dental treatment (Trusculescu, et al., 2025). VR was also used in a more limited capacity in perioperative preparation and during chemotherapy-related visits (Gerçeker et al. 2024). These findings are consistent with previous VR literature (Iqbal et al., 2024), which suggests that VR is particularly well suited to brief, high-stress clinical encounters (Iqbal et al., 2024). At the same time, the results highlight a notable discrepancy between the theoretical potential of VR and its current use in pediatric care. Several applications described in the broader evidence base (Kouijzer et al. 2023), such as rehabilitation, intensive care, or long-term therapeutic use, remain largely unexplored in pediatric contexts.

Another notable discrepancy emerged in relation to immersion. While theoretical VR literature emphasises immersion and interactivity as fundamental components of the VR experience (LaValle, 2023; Wu, 2024), many of the included studies relied on passive VR videos rather than fully immersive environments (Gerards et al., 2025; Goldman & Behboudi, 2021; Reitze et al., 2024). As a result, the theoretical potential of VR was not fully utilised in pediatric care contexts, which may partly explain the variability in outcomes related to anxiety reduction.

Developmental considerations also surfaced as an area of inconsistency. Despite manufacturer recommendations suggesting that VR headsets are suitable from approximately 12–13 years of age, several studies included very young children, even infants (e.g. Khadra et al. 2020; Xiang et al. 2021). This raises questions about developmental appropriateness and highlights the need for clearer age-specific principles to guide the safe and meaningful use of VR in pediatric healthcare.

A further discrepancy concerned the multisensory nature of VR. Theoretical descriptions characterise VR as a multisensory technology that may include visual, auditory, tactile or even olfactory elements (Ambrosio and Fidalgo, 2020). In practice, however, nearly all interventions in this review relied on purely visual content (e.g. Gerards et al., 2025; Goktas & Avci, 2023; Reitze et al., 2024). This limitation narrows the potential richness of the VR experience and may influence how strongly or effectively children engage with the intervention.

Taken together, while VR appears particularly beneficial for reducing pain, its effects on anxiety and fear are more dependent on contextual, developmental and technological factors. The findings also illustrate several mismatches between the theoretical foundations of VR and the practical implementation of VR interventions in pediatric contexts, underscoring the need for more nuanced and developmentally grounded research designs as well as more advanced, immersive VR applications.

A small number of studies examined the use of VR in perioperative care, offering a nuanced view of its potential and limitations (e.g. Chan et al. 2022). Findings on preoperative anxiety were inconsistent: while Gold et al. (2021) reported a substantial reduction in anxiety with interactive VR during surgical preparation, Chen et al. (2025) found no comparable effect when children viewed animated content through a VR headset. These divergent results may reflect differences in immersion level, developmental appropriateness of the content, or the extent to which the VR environment actively engages the child. The role of immersion also emerged elsewhere in the review, with some studies suggesting that high levels of immersion may enhance pain reduction (e.g., Chen et al., 2025), while others indicated that less immersive VR solutions can adequately reduce distress (e.g., Caruso et al., 2020). Taken together, surgery related evidence highlights that immersion is not uniformly beneficial and that VR's effectiveness likely depends on the interplay between technological characteristics, developmental factors and the clinical context in which the intervention is used (Chen et al., 2025; Gold et al., 2021).

Although VR did not consistently reduce preoperative anxiety, its benefits became more apparent in the postoperative phase. Chen et al. (2025) reported reductions in postoperative pain, emergence delirium and procedure-related nausea. These results suggest that VR may have a broader role in perioperative symptom management than previously acknowledged, particularly when immersive content is used. They also indicate that VR's effectiveness may depend on the timing and nature of the intervention rather than the perioperative phase alone.

The variability observed between studies also reflects the broader heterogeneity of the current research landscape. Differences in study designs, sample characteristics, intervention formats and outcome measures make it challenging to determine the extent to which the reported effects are attributable to VR itself or to contextual factors that vary from one study to another. Many studies provided limited detail about how VR was delivered (e.g. Goktas & Avci 2023), the role of healthcare staff or parents during the intervention, or the specific characteristics of the VR content, which makes comparisons across studies difficult. From a mapping perspective, these findings highlight that the field is still developing and that greater methodological consistency and more detailed reporting would enhance the understanding of how VR is applied and experienced in pediatric settings.

Gold et al. (2021) discussed how major VR headset manufacturers typically recommend that their devices be used only by individuals aged 12–14 years and older. Some headsets explicitly state that they should not be used by children under 13. According to the authors, this is largely due to the fact that VR headset use generally requires creating a user account. In hospital settings, however, no personal account is needed, as a unit-level account can be used for all patients. In addition, VR use usually requires parental consent, which can be routinely obtained in pediatric care, and parents also have the option to decline VR use for their child.

The use of VR headsets in clinical care situations has also been considered from the perspective of medical device legislation. Gold et al. (2021) state that when a game or headset is used solely as a distraction method, it does not constitute a medical device in the legal sense. Similar to the way a television or tablet can be used purely for distraction.

Gold et al. (2021) also reviewed the issue from the perspective of eye health. Ophthalmologists generally do not recommend VR use for children under 6 years old; however, research has not identified adverse effects associated with short-term use in children under 12. The authors reviewed several studies involving participants aged 4–12 years.

Most studies were conducted in research settings, where the use of VR was guided by researchers or individual clinicians, and there was no reporting on the integration of VR into daily care routines, staff competencies, or organizational-level implementation. (See results section 5.1) Which suggests that although the potential applications of VR and patient experiences appear promising, VR does not yet seem to be a systematic component of pediatric care practice. Research is needed to describe the practical implementation of VR, including resources, training, and care processes. This lack of evidence also means that the second part of the first research question—concerning how VR is currently used in practice and what established applications exist in pediatric care—remains unanswered. The studies identified in this review provided no indication that VR has yet been adopted as a routine or established element of everyday pediatric care.

While VR has been suggested as a potential tool in intensive care and rehabilitation environments (Iqbal et al., 2024), no pediatric ICU studies were identified in this review. This gap points to a clear discrepancy between theoretical possibilities and existing clinical research and highlights pediatric ICU applications as an unexplored domain requiring further investigation.

Although VR has been used in broader pediatric contexts such as neurodevelopmental disorders and rehabilitation (Oyekunle et al., 2024), these applications were not represented in the studies included in this review. This absence reinforces the finding that current VR research within pediatric care remains heavily focused on acute procedural contexts.

6.2 Implications for care practice

The findings of this scoping review indicate that virtual reality can support pediatric care, especially during procedures that commonly cause pain and distress. Several studies reported that VR reduced children’s pain and discomfort, which suggests that it may serve as a useful non-pharmacological option either on its own or alongside other methods. This seems particularly helpful in procedures such as venipuncture, cannulation, burn care and fracture treatment, where children often experience heightened distress.

The effects on anxiety and fear, however, were more mixed. This underlines the importance of choosing VR content carefully. Not all VR applications are equally engaging or immersive, and factors such as interactivity, visual quality and age appropriate design can influence how children respond emotionally (LaValle, 2023; Wu, 2024). Based on the studies reviewed, interactive VR tends to be more effective than passive videos, but its usefulness still depends on the child and the situation.

The review also emphasised the centrality of family involvement in pediatric care. Because parents play a critical role in the child's sense of safety and emotional regulation, VR interventions should not replace parental presence, preparation or support. Instead, VR should be integrated into a broader family-centred care approach, in which parents are informed about the purpose of VR, given opportunities to participate and supported in helping their child engage with the intervention. (Christian, 2013; Storvik-Sydänmaa, 2019.) Nurses may also need to assess whether the VR experience complements or competes with the family's own coping mechanisms.

Developmental considerations are equally important. Some studies used VR with very young children, even though headset manufacturers provide age recommendations. Before offering VR, nurses should consider whether the child can tolerate the device, understand the content and remain comfortable during use. VR is not suitable for every child, and individual temperament, previous medical experiences and coping abilities can influence whether the intervention is helpful. Children vary considerably in temperament, prior exposure to medical procedures and emotional coping capacities, (Christian, 2013) which means that VR may not be equally suitable or effective for every child. These individual factors should be considered when planning VR use in clinical practice.

As VR is not yet fully established in routine pediatric care, successful implementation requires organisational support. Nurses may need practical training on equipment, troubleshooting and content selection. Clear guidance on hygiene practices, safety monitoring and workflow integration would support more consistent use. Pilot projects or structured evaluations could help organisations determine where VR is most effective and feasible.

Finally, the review highlights the importance of aligning VR interventions with the values of pediatric care. When used thoughtfully and appropriately, VR can support the nurse's role in reducing suffering, promoting emotional wellbeing, strengthening collaboration, and improving the overall care experience for children and their families.

6.3 The ethics of using virtual reality in pediatric care

The ethical use of virtual reality in pediatric care requires careful attention to the child's developmental stage, safety, and ability to provide meaningful assent. Young children may have limited capacity to understand the nature of a simulated environment, which raises ethical considerations related to consent, emotional vulnerability, and potential misunderstandings about what is real and what is not (Christian, 2013; Storvik-Sydänmaa, 2019). VR is generally seen as safe, but because most devices are recommended for children aged 12–13 and older, nurses should consider whether VR fits the child's developmental stage and observe for any discomfort or sensory overload (Lum et al., 2020).

Because parents play an essential role in a child's coping and emotional regulation, VR should be used in a way that supports family-centred care. This means giving parents clear information about why VR is used, what it may help with, and any limitations, so they can support their child and give informed permission (Christian, 2013; Storvik-Sydänmaa, 2019). VR can be helpful, but it cannot replace therapeutic communication, preparation or the support children receive from their parents. If technology were used in place of these relational elements, it would contradict the core values of pediatric care, which focus on presence, communication and helping children feel safe.

The fast pace of VR development also raises some ethical questions. For example, systems that track user behaviour may create privacy concerns, and access to new technologies is not always equal. Clinicians also need to base decisions on evidence rather than excitement around new tools (LaValle, 2023; Ambrosio & Fidalgo, 2020). As VR begins to appear more often in pediatric settings, it will be important to establish clear guidance and to reflect regularly on how the technology is used, so that children's rights, well-being and developmental needs remain central.

6.4 Strengths and limitations

A strength of this scoping review is the extensive and systematic literature search and the comprehensive mapping of different VR applications and use cases in pediatric care. The scoping review methodology enabled a broad exploration of the field and the identification of knowledge gaps without assessing the effectiveness or quality of individual interventions, which is consistent with the purpose of scoping reviews (Arksey & O'Malley, 2005; Peters et al., 2020).

A key limitation of the review is the considerable heterogeneity of VR interventions, research designs and outcome measures across the included studies. This variability limits comparability and makes it difficult to draw firm conclusions about the effectiveness or generalisability of VR applications. In addition, many studies had small sample sizes, and the reporting of practical implementation details—such as staff involvement, workflow integration, and content selection—was inconsistent, which is also noted as a common challenge in VR research broadly (Kouijzer et al., 2023).

Another limitation relates to the minimal attention given to family perspectives and organisational implementation in the included studies. Given that family-centred care is central to pediatric care (Christian, 2013; Storvik-Sydänmaa, 2019), the limited reporting of parents' experiences and the absence of studies describing routine clinical use restrict the understanding of how VR aligns with core care frameworks.

It is also inherent to the scoping review methodology that no formal quality appraisal is conducted (Arksey & O'Malley, 2005; Peters et al., 2020). As a result, the methodological rigour of the included studies may vary substantially, which may influence how comprehensively the review reflects current VR use in pediatric care.

The scoping review process also involves several stages requiring researcher judgement—such as formulating the research questions, defining inclusion and exclusion criteria, selecting search terms, screening studies and synthesising findings. Although these steps were conducted systematically, they carry the potential for selection bias, particularly given the restriction to English-language and peer-reviewed publications.

The rapid development of VR technology presents an additional limitation. The included studies span a period during which VR devices, ergonomics and content quality evolved significantly, making comparisons between older and newer studies methodologically challenging (LaValle, 2023).

Although the inclusion criteria were designed to capture studies relevant to pediatric care and the child's experience, they may not have been sensitive enough to identify VR research where family participation plays a central role but where the focus of the study was not explicitly defined as pediatric care. Scoping reviews often risk overlooking studies situated at the boundaries of the predefined concepts, particularly when complex constructs such as "family-centred care" or "patient experience" are operationalised narrowly during screening (Arksey & O'Malley, 2005; Colquhoun et al., 2014). As a result, some studies involving parents or family-centred VR applications—particularly those situated in psychosocial care, home-based interventions or interdisciplinary rehabilitation—may not have been captured by the search strategy. This reflects a well-documented methodological challenge in scoping review methodology, in which inclusion and exclusion decisions inevitably shape the comprehensiveness of the evidence map (Tricco et al., 2018; Peters et al., 2020).

In addition to methodological considerations, several practical constraints inherent to VR technology may influence its applicability in pediatric care. These include device costs, hygiene-related requirements and the limited availability of child-appropriate VR content, all of which affect the feasibility of routine clinical use (Baniasadi et al., 2020). These factors underline the need for further research on how VR can be safely and sustainably integrated into pediatric care environments.

6.5 Future research

The findings of this scoping review point to several areas in which further research is needed to advance the evidence base for virtual reality in pediatric care. First, although VR showed the most consistent benefits in the management of procedural pain, its effects on anxiety and fear varied considerably. Future studies should examine more closely which components of VR—such as level of immersion, interactivity, sensory complexity, narrative features or duration of use—are most influential in reducing emotional distress, and how these components can be optimised for different age groups.

More research is also required to address the notable absence of VR applications in several pediatric care contexts. Despite promising evidence from adult populations, no studies were identified in pediatric intensive care, rehabilitation, long-term hospitalization or psychiatric care. These settings represent significant opportunities for future investigation, particularly given the potential of VR to enhance coping, support emotional regulation and enrich therapeutic engagement in children undergoing prolonged or demanding treatments.

Another important area for future research concerns developmental suitability. Studies included in this review used VR with very young children, even though age recommendations for VR headsets typically begin at 12–13 years. Research is needed to establish age-appropriate guidelines, assess the sensory and cognitive demands of VR for different developmental stages, and examine potential short- and long-term effects of early VR exposure.

Future research should also further examine VR within a family-centred care framework. Although parental involvement is a cornerstone of pediatric care, the studies included in this review provided little insight into parents' experiences, preferences, or roles in supporting their child during VR use. It remains unclear whether VR complements or competes with parents' comforting strategies, and how nurses might best integrate VR without diminishing the parent's role in creating a sense of safety. Moreover, none of the identified studies involved shared VR experiences or explored how joint participation of parent and child might influence the child's emotional regulation, cooperation, or overall care experience. Given the theoretical importance of family-centred care, research is needed to develop and evaluate VR interventions that allow parents to participate directly, either through parallel VR environments, joint viewing modes, or interactive elements designed specifically for dyadic or triadic use.

In addition, there is a clear need for implementation-focused research. Most studies included in this review were conducted under controlled research conditions and did not describe how VR could be integrated into routine pediatric care workflows. Because the inclusion criteria of this scoping review focused specifically on the child's perspective and excluded studies centred on staff experiences or organisational processes, the review was not able to capture the extent to which implementation research may already exist. It therefore remains unclear how widely VR has been adopted in everyday clinical practice or how healthcare organisations have addressed issues such as feasibility, resource requirements, staff training, hygiene and safety protocols, or long-term maintenance. Future research should explore these aspects more explicitly to provide a more comprehensive understanding of real world implementation and the sustainability of VR-supported care.

Methodologically, future research would benefit from more robust and consistent study designs. Although several of the included studies compared VR with standard care or alternative distraction methods, the heterogeneity of comparison groups and VR modalities makes it difficult to draw broader conclusions about relative effectiveness. Future studies would benefit from larger sample sizes, more detailed reporting of VR content and technology, and the use of validated, developmentally appropriate outcome measures. In addition, comparative research that systematically examines different levels of immersion, such as immersive head-mounted VR, semi-immersive environments, and non-VR distraction techniques would help clarify under which circumstances VR provides added value beyond existing approaches.

As VR technology continues to evolve, there is also a growing need to explore advanced features, such as haptic feedback, multisensory environments, adaptive gameplay or biofeedback-based regulation, and how these may enhance clinical usefulness. Emerging modalities, including augmented reality and mixed reality, may further expand the possibilities for pediatric care and warrant systematic exploration.

Taken together, the gaps identified in this review highlight a rich and necessary agenda for future research. Advancing the evidence base will require interdisciplinary collaboration, developmentally informed approaches, and a stronger focus on implementation to ensure that VR can be used safely, effectively and sustainably within pediatric care practice.

7 CONCLUSION

The findings of this scoping review demonstrate that virtual reality (VR) is primarily used in pediatric care as a non-pharmacological method to reduce pain, anxiety, fear, and procedural distress. The interventions were most frequently applied in acute and invasive care situations, including venipuncture, burn treatment, fracture management, catheter insertion and vaccinations, where VR was consistently associated with decreases in both self-reported and observed discomfort. In addition, VR supported children’s emotional regulation and contributed to calmer, more positive care experiences.

Most studies also reported improved cooperation, reduced need for restraint and smoother interactions between children and healthcare professionals, while a smaller number highlighted benefits for the overall care experience from the perspectives of both children and parents.

The review further indicates that VR use in pediatric care remains at an early stage of development. Most included studies were experimental or pilot projects undertaken under controlled conditions, and no evidence was found of systematic or routine clinical implementation. This gap suggests that translating promising experimental results into everyday practice remains an important goal for future research.

Taken together, the findings show that VR represents a promising non-pharmacological tool for supporting children during painful and stressful procedures. Its future integration into pediatric care will depend on more consistent methodological approaches, improved reporting, and research that addresses real-world implementation and family-centred care considerations.

REFERENCES

Alrashidi, M., Tomlinson, R. J., Buckingham, G., & Williams, C. A. (2025). Virtual reality current use, facilitators and barriers to implementation in paediatric physiotherapy: cross-sectional online survey of UK paediatric physiotherapists. *Disability and Rehabilitation: Assistive Technology*, *20*(3), 585–591. https://doi.org/10.1080/17483107.2024.2393695

Ambrosio, A. P., & Fidalgo, M. I. R. (2020). Past, present and future of Virtual Reality: Analysis of its technological variables and definitions. *Culture & History Digital Journal*, *9*(1), 010. https://doi.org/10.3989/CHDJ.2020.010

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. International journal of social research methodology, 8(1), 19-32. https://doi.org/10.1080/1364557032000119616

Aydos, İ. A., Semerci, R., Savaş, E. H., Gülersoy, A., & Ürey, H. (2024). Golden Breath: Feasibility and acceptability of a biofeedback-based virtual reality game on reducing children's needle-related pain and fear. *Journal of Pediatric Care*, *79*, 186–196. https://doi.org/10.1016/j.pedn.2024.09.008

Baniasadi, T., Ayyoubzadeh, S. M., & Mohammadzadeh, N. (2020). Challenges and Practical Considerations in Applying Virtual Reality in Medical Education and Treatment. *Oman medical journal*, *35*(3), e125. https://doi.org/10.5001/omj.2020.43

Boyles, B. (2017) Virtual Reality and Augmented Reality in Education. https://www.westpoint.edu/sites/default/files/inline-images/centers_research/center_for_teching_excellence/PDFs/mtp_project_papers/Boyles_17.pdf

Butt, M., Kabariti, S., Likourezos, A., Drapkin, J., Hossain, R., Brazg, J., & Motov, S. (2022). Take-Pause: Efficacy of mindfulness-based virtual reality as an intervention in the pediatric emergency department. *Academic Emergency Medicine*, *29*(3), 270–277. https://doi.org/10.1111/acem.14412

Caruso, T. J., George, A., Menendez, M., de Souza, E., Khoury, M., Kist, M. N., & Rodriguez, S. T. (2020). Virtual reality during pediatric vascular access: A pragmatic, prospective randomized, controlled trial. *Paediatric Anaesthesia*, *30*(2), 116–123. https://doi.org/10.1111/pan.13778

Chan, E., Hovenden, M., Ramage, E., Ling, N., Pham, J. H., Rahim, A., Lam, C., Liu, L., Foster, S., Sambell, R., Jeyachanthiran, K., Crock, C., Stock, A., Hopper, S. M., Cohen, S., Davidson, A., Plummer, K., Mills, E., Craig, S. S., Leong, P. (2019). Virtual Reality for Pediatric Needle Procedural Pain: Two Randomized Clinical Trials. *Journal of Pediatrics*, *209*, 160-167.e4. https://doi.org/10.1016/j.jpeds.2019.02.034

Chen, H., Chen, L., Zhu, C., Li, S., Zhou, J., & Liu, C. (2025). Immersive Virtual Reality Versus Video Distraction for the Management of Emergence

Delirium in Children: A Randomized Controlled Study. *Journal of Perianesthesia Care*, *40*(2), 318–325. https://doi.org/10.1016/j.jopan.2024.05.006

Christian, B. J. (2013). The Essence of Pediatric Care—Translating Evidence to Improve Pediatric Care for Children, Their Parents and Families. Journal of pediatric care, 28(2), 193-195. https://doi.org/10.1016/j.pedn.2013.02.023

Clarke, S. (2017). The History of Children's Care and Its Direction Within the United Kingdom. *Comprehensive Child & Adolescent Care*, *40*(3), 200–214. https://doi.org/10.1080/24694193.2017.1316790

Comparcini, D., Simonetti, V., Tomietto, M., Leino-Kilpi, H., Pelander, T., & Cicolini, G. (2018). Children's Perceptions About the Quality of Pediatric Care: A Large Multicenter Cross-Sectional Study: Quality of Pediatric Care. Journal of care scholarship, 50, 287-295. https://doi.org/10.1111/jnu.12381

Cvetković, D. (2021). *Virtual Reality and Its Application in Education*. Introductory Chapter: Virtual Reality. IntechOpen. https://doi: 10.5772/intechopen.91950

Diaz-Hennessey, S., O'Shea, E. R., & King, K. (2019). Virtual Reality: Augmenting the Acute Pain Experience in Children. *Pediatric Care*, *45*(3), 122–127. https://research.ebsco.com/linkprocessor/plink?id=81ba8bbd-d002-37e4-a049-50f3bb014042

Diogo, P., Martins de Freitas, B. H. B., Lourenço da Costa, A. I., & Munhoz Gaíva, M. A. (2021). Care in pediatric care from the perspective of emotions: from Nightingale to the present. *Revista Brasileira De Enfermagem*, *74*(4). https://doi.org/10.1590/0034-7167-2020-0377

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of advanced care, 62*(1), 107-115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Erdogan, B., & Aytekin Ozdemir, A. (2021). The Effect of Three Different Methods on Venipuncture Pain and Anxiety in Children: Distraction Cards, Virtual Reality, and Buzzy® (Randomized Controlled Trial). *Journal of Pediatric Care*, *58*, e54–e62. https://doi.org/10.1016/j.pedn.2021.01.001

Etheridge, S., Corcoran, J., Armstrong, A., Bryant, P. H., Coleman, E., Hyde, H., Jordan, J., Rice, M., Wheeler, Y., & Smith, T. S. (2024). Pediatric Care: Then and Now. *Pediatric Care*, *50*(5), 215–218. https://doi.org/10.62116/PNJ.2024.50.5.215

Fabricant, P. D., Gross, P. W., Mackie, A. T., Heath, M. R., Pascual-Leone, N., Denneen, J. P., Gelley, P. E., Scher, D. M., & Ipp, L. S. (2024). Virtual Reality Distraction Is No Better Than Simple Distraction Techniques for Reducing Pain and Anxiety During Pediatric Orthopaedic Outpatient Procedures: A Randomized Controlled Trial. *Clinical Orthopaedics and Related Research*, *482*(5), 854–863. https://doi.org/10.1097/CORR.0000000000002889

Finnish National Board on Research Integrity. (2023). *Responsible conduct of research and procedures for handling allegations of misconduct: Guidelines 2023*. https://tenk.fi/sites/default/files/2023-05/RI_Guidelines_2023.pdf

Flores, A., Hoffman, H. G., Navarro-Haro, M. V., Garcia-Palacios, A., Atzori, B., le May, S., Alhalabi, W., Sampaio, M., Fontenot, M. R., & Mason, K. P. (2023). Using Immersive Virtual Reality Distraction to Reduce Fear and Anxiety before Surgery. *Healthcare (Switzerland)*, *11*(19). https://doi.org/10.3390/healthcare11192697

Galiana-Sánchez, M. (2017). The Role of International Organisations in the Development of Public Health Care, 1933–1974. Gesnerus - Swiss Journal of the History of Medicine and Sciences. 74. 188-204. https://doi.org/10.24894/Gesn-en.2017.74009.

Gartner, JB., Abasse, K.S., Bergeron, F. *et al.* (2022) Definition and conceptualization of the patient-centered care pathway, a proposed integrative framework for consensus: a Concept analysis and systematic review. *BMC Health Serv Res* **22**, 558. https://doi.org/10.1186/s12913-022-07960-0

Gerards, M., Miller, J., Doshi, D., Hoyer, A., Flöttmann, N., & Barthlen, W. (2025). Virtual reality for distraction during painful procedures in pediatric surgery: A randomized clinical trial. *Journal of Pediatric Care*, *82*, 116–122. https://doi.org/10.1016/j.pedn.2025.03.001

Gerçeker, G. Ö., Bektaş, M., Önal, A., Kudubeş, A. A., & Çeçen, R. E. (2024). The Effect of Virtual Reality Distraction and Fatigue Training on Anxiety and Fatigue Levels in Children with Cancer: A Randomized Controlled Study. *Seminars in Oncology Care*, *40*(6). https://doi.org/10.1016/j.soncn.2024.151725

Goktas, N., & Avci, D. (2023). The effect of visual and/or auditory distraction techniques on children's pain, anxiety and medical fear in invasive procedures: A randomized controlled trial. *Journal of Pediatric Care*, *73*, e27–e35. https://doi.org/10.1016/j.pedn.2023.07.005

Gold, J. I., Annick, E. T., Lane, A. S., Ho, K., Marty, R. T., & Espinoza, J. C. (2021). "Doc McStuffins: Doctor for a Day" Virtual Reality (DocVR) for pediatric preoperative anxiety and satisfaction: Pediatric medical technology feasibility study. *Journal of Medical Internet Research*, *23*(4). https://doi.org/10.2196/25504

Goldman, R. D., & Behboudi, A. (2021). Virtual reality for intravenous placement in the emergency department—a randomized controlled trial. *European Journal of Pediatrics*, *180*(3), 725–731. https://doi.org/10.1007/s00431-020-03771-9

Herrera, M. D. L. C., Fuster-Casanovas, A., Catalina, Q. M., Mensa, M. C., Guitart, I. V., Sedeño, A. A., Vidal-Alaball, J., & Carrión, S. G. (2025). Use of virtual reality in the reduction of pain after the administration of vaccines among children in primary care centers in Central Catalonia: Randomized clinical trial. *PLoS ONE*, *20*(5 May). https://doi.org/10.1371/journal.pone.0322840

Huang, Y. T., Addab, S., Bertolizio, G., Hamdy, R., Thorstad, K., & Tsimicalis, A. (2025). Use of Virtual Reality in the Pediatric Perioperative Setting and for Induction of Anesthesia: Mixed Methods Pilot Feasibility Study. *JMIR Perioperative Medicine*, *8*, e58905. https://doi.org/10.2196/58905

Iqbal AI, Aamir A, Hammad A, Hafsa H, Basit A, Oduoye MO, Anis MW, Ahmed S, Younus MI, Jabeen S. (2024) Immersive Technologies in Healthcare: An In-Depth Exploration of Virtual Reality and Augmented Reality in Enhancing Patient Care, Medical Education, and Training Paradigms. Journal of Primary Care & Community Health. Volume 15: 1-13. https://doi.org/10.1177/21501319241293311

Ji, S. (2024). The Role of Virtual Reality Technology in Medical Applications: A Review. Applied and Computational Engineering. 114. 60-64. https://doi.org/10.54254/2755-2721/2024.18216.

Ji, S. (2024). The Role of Virtual Reality Technology in Medical Applications: A Review. Applied and Computational Engineering. 114. 60-64. https://doi.org/10.54254/2755-2721/2024.18216.

Khadra, C., Ballard, A., Paquin, D., Cotes-Turpin, C., Hoffman, H. G., Perreault, I., Fortin, J. S., Bouchard, S., Théroux, J., & le May, S. (2020). Effects of a projector-based hybrid virtual reality on pain in young children with burn injuries during hydrotherapy sessions: A within-subject randomized crossover trial. *Burns*, *46*(7), 1571–1584. https://doi.org/10.1016/j.burns.2020.04.006

Kouijzer, M. M. T. E., Kip, H., Bouman, Y. H. A., & Kelders, S. M. (2023). Implementation of virtual reality in healthcare: A scoping review on the implementation process of virtual reality in various healthcare settings. Implementation science communications, 4(1), 67. https://doi.org/10.1186/s43058-023-00442-2

Kucher, N., Larson, J. M., Fischer, G., Mertaugh, M., Peterson, L., & Gershan, L. A. (2020). 3-Dimensional nature-based therapeutics in pediatric patients with total pancreatectomy and islet auto-transplant. *Complementary Therapies in Medicine*, *48*. https://doi.org/10.1016/j.ctim.2019.102249

LaValle, S. M. (2023) Virtual Reality. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781108182874

le May, S., Hupin, M., Khadra, C., Ballard, A., Paquin, D., Beaudin, M., Bouchard, S., Cotes-Turpin, C., Noel, M., Guingo, E., Hoffman, H. G., Déry, J., Hung, N., & Perreault, I. (2021). Decreasing Pain and Fear in Medical Procedures with a Pediatric Population (DREAM): A Pilot Randomized Within-Subject Trial. *Pain Management Care*, *22*(2), 191–197. https://doi.org/10.1016/j.pmn.2020.10.002

Lum, H. C., Elliott, L. J., Aqlan, F., & Zhao, R. (2020). Virtual Reality: History, Applications, and Challenges for Human Factors Research. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 64(1), 1263-1268. https://doi.org/10.1177/1071181320641300

Martínez-Rodríguez, L., García-Bravo, C., García-Bravo, S., Salcedo-Pérez-Juana, M., & Pérez-Corrales, J. (2025). New Technological Approaches in Occupational Therapy for Pediatric Cerebral Palsy: A Systematic Review. *Healthcare (Basel, Switzerland)*, *13*(5), 459. https://doi.org/10.3390/healthcare13050459

Martínez-Rodríguez, L., García-Bravo, C., García-Bravo, S., Salcedo-Pérez-Juana, M., & Pérez-Corrales, J. (2025). New Technological Approaches in Occupational Therapy for Pediatric Cerebral Palsy: A Systematic Review. In *Healthcare (Switzerland)* (Vol. 13, Issue 5). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/healthcare13050459

Mesa-Burbano, A. E., Fernández-Polo, M. A., Hurtado-Sánchez, J. S., Betancur-Bedoya, S. P., Quiguanas-López, D. M., & Ordoñez-Mora, L. T. (2025). Effects of Virtual Reality Use on Children with Cerebral Palsy and Its Applications in Health: A Systematic Review. Healthcare, 13(20), 2571. https://doi.org/10.3390/healthcare13202571

Mesa-Burbano, A. E., Fernández-Polo, M. A., Hurtado-Sánchez, J. S., Betancur-Bedoya, S. P., Quiguanas-López, D. M., & Ordoñez-Mora, L. T. (2025). Effects of Virtual Reality Use on Children with Cerebral Palsy and Its Applications in Health: A Systematic Review. In *Healthcare (Switzerland)* (Vol. 13, Issue 20). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/healthcare13202571

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC medical research methodology, 18(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Oyekunle D, Matthew UO, Waliu AO, Fatai LO. (2024) Healthcare applications of Augmented Reality (AR) and Virtual Reality (VR) simulation in clinical ceducation. J Clin Images Med Case Rep. 2024; 5(6): 3141. https://doi.org/10.52768/2766-7820/3141

Pallidine, C., & Goldin, D. (2025). Virtual Reality Use in Pediatric Emergency Department Pain Management: Illustrative Case Report. *Journal of Emergency Care*, *51*(2), 189–194. https://doi.org/10.1016/j.jen.2024.10.008

Peters, M., Godfrey, C., McInerney, P., Munn, Z., Tricco, A.C., Khalil, H. (2020) Scoping Reviews. Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. *JBI Manual for Evidence Synthesis*. JBI; 2024. Retrieved August 10, 2025, from https://synthesismanual.jbi.global. https://doi.org/10.46658/JBIMES-24-09

Piskorz, J., & Czub, M. (2018). Effectiveness of a virtual reality intervention to minimize pediatric stress and pain intensity during venipuncture. *Journal for Specialists in Pediatric Care*, *23*(1). https://doi.org/10.1111/jspn.12201

Polit, D.F. & Beck, C. (2017) Care Research: Generating and Assessing Evidence for Care Practice. 10th Edition, Wolters Kluwer Health, Philadelphia, 784 p. https://doi.org/10.1016/j.iccn.2015.01.005

Pollock, D., Peters, M., Khalil, H., McInerney, P., Alexander, L., Tricco, A., Evans, C., de Moraes, E. B., Godfrey, C., Pieper, D., Saran, A., Stern, C., Munn, Z. (2023) Recommendations for the extraction, analysis, and presentation of results in scoping reviews. JBI Evidence Synthesis 21(3):p 520-532, March 2023. https://doi.org/10.11124/JBIES-22-00123

Reitze, A., Voigt, M., Klawonn, F., Dusch, M., Grigull, L., & Mücke, U. (2024). Impact of virtual reality on peri-interventional pain, anxiety and distress in a pediatric oncology outpatient clinic: a randomized controlled trial. *BMC Pediatrics*, *24*(1). https://doi.org/10.1186/s12887-024-04952-3

Satakunta University of Applied Sciences. (2023) SAMK Reference Guide APA 7 SAMK. 25.8.2023 https://samk.finna.fi/themes/custom/files/samkreferenceguide.pdf

Savaş, E. H., Semerci, R., Sayın, A., Dinçer, B., Semiz, B., & Ürey, H. (2024). A Biofeedback Based Virtual Reality Game for Pediatric Population (BioVirtualPed): A Feasibility Trial. *Seminars in Oncology Care*, *40*(2). https://doi.org/10.1016/j.soncn.2024.151615

Schlechter, A. K., Whitaker, W., Iyer, S., Gabriele, G., & Wilkinson, M. (2021). Virtual reality distraction during pediatric intravenous line placement in the emergency department: A prospective randomized comparison study. *American Journal of Emergency Medicine*, *44*, 296–299. https://doi.org/10.1016/j.ajem.2020.04.009

Seniwati, T., Rustina, Y., Nurhaeni, N., & Wanda, D. (2023). Patient and family-centered care for children: A concept analysis. *Belitung care journal*, *9*(1), 17–24. https://doi.org/10.33546/bnj.2350

Storvik-Sydänmaa, S., Tervajärvi, L., Hammar, A., Flinck, M., Müller, E., Sinivuori, E., & Hyvärinen, H. (2019). *Lapsen ja perheen hoitotyö*. Sanoma Pro Oy.

Tricco A, Lillie E, Zarin W, O'Brien K, Colquhoun H, Levac D, et al. (2018). PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018; 169: 467–473. https://doi.org/10.7326/M18-0850

Trusculescu, L. M., Pitic, D. E., Sălcudean, A., Popovici, R. A., Forna, N., Badoiu, S. C., Enache, A., Enasoni, S., Kiș, A., Cosoroabă, R. M., Talpos-Niculescu, C. I., Zeicu, C. C., Cozma, M. M., & Todor, L. (2025). Virtual Reality as a Non-Pharmacological Aid for Reducing Anxiety in Pediatric Dental Procedures. *Children*, *12*(7). https://doi.org/10.3390/children12070930

UNICEF UK. (1989). *The United Nations convention on the rights of the child.* https://downloads.unicef.org.uk/wp-content/uploads/2010/05/UNCRC_PRESS200910web.pdf?_ga=2.78590034.795419542.1582474737-1972578648.1582474737

van den Berg, S., Hoogeveen, M. O., van Winden, T. M. S., Chegary, M., Genco, M. S., & Jonkman, N. H. (2023). Virtual reality hypnosis for needle-related procedural pain and fear management in children: a non-inferiority randomized trial. *European Journal of Pediatrics*, *182*(10), 4421–4430. https://doi.org/10.1007/s00431-023-05116-8

Varantola, K., Launis,V., Helin, M., Spoof, S. K. & Jäppinen, S. (2012) Responsible conduct of research and procedures for handling allegations of misconduct in Finland. Guidelines of the Finnish Advisory Board on Research Integrity 2012. Updated 23.10.2023. Helsinki. https://tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf

Whittemore, H., Chase, S.K. & Mandle, C. L. (2001) Validity in quality research. Qualitative Health Research, 11, 522-537. https://doi.org/10.1177/104973201129119299

Wong, C. L., Lui, M. M. W., & Choi, K. C. (2019). Effects of immersive virtual reality intervention on pain and anxiety among pediatric patients undergoing venipuncture: A study protocol for a randomized controlled trial. *Trials*, *20*(1). https://doi.org/10.1186/s13063-019-3443-z

Wu, X. (2024). A review of virtual reality technology. Applied and Computational Engineering. 38. 1-6. https://doi.org/10.54254/2755-2721/38/20230521.

Xiang, H., Shen, J., Wheeler, K. K., Patterson, J., Lever, K., Armstrong, M., Shi, J., Thakkar, R. K., Groner, J. I., Noffsinger, D., Giles, S. A., & Fabia, R. B. (2021). Efficacy of smartphone active and passive virtual reality distraction vs standard care on burn pain among pediatric patients a randomized clinical trial. *JAMA Network Open*, *4*(6), E2112082. https://doi.org/10.1001/jamanetworkopen.2021.12082

Zipursky, A. (2002). A History of Pediatric Specialties. *Pediatric Research*, *52*(5), 617. https://doi.org/10.1203/00006450-200211000-00002

APPENDIX 1: RESEARCH ARTICLES

Article name	Author(s), year	Clinical setting	Age	Purpose of use of VR	In use?	Device	Software content	Interaction level	Results
Impact of virtual reality on peri-interventional pain, anxiety and distress in a pediatric oncology outpatient clinic: a randomized controlled trial	A. Reitze et al. 2022	Pediatricoutpatient clinic of oncology .	6 - 18	**Pain, anxiety and distress management** during port puncture, placement of a peripheral venous catheter, lumbar puncture, bone marrow puncture or use of broviac catheter.	Not known.	VR goggles.	Three optional videos.	Low, videos only.	Effective in reducing peri-interventional pain, anxiety and distress compared with standard care. 71% of patients and 76% of parents assessed punctures with VR to be more relaxed than previous ones. 95% of patients perceived fun with VR goggles.
Virtual reality distraction during pediatric intravenous line placement in the emergency department: A prospective randomized comparison study	A. Schlechter et al. 2020	Emergency department at pediatric hospital	6 - 17	Intravenous catheter insertion; increasing the sucsession of first attempt and **pain and anxiety management.**	Not in use.	VR headset and optional headphones	Game; an whale swims through the ocean, and subtle movements of the head can direct the narwhal through hoops, up above the ocean, or down to the base of the ocean.	Middle level.	*No signifficant differencies between VR and standard of care.* VR distraction appears to be well tolerated. Number of IV attempts and changes in pain and anxiety scores were also similar between the groups.
Effects of a projector-based hybrid virtual reality on pain in young children with burn injuries during hydrotherapy sessions: A within-subject randomized crossover trial	C. Khadra et al. 2020	Pediatric surgical-trauma burn unit at university hospital.	0 - 7	**Pain management** during hydropterapy session for burn wounds; including wound cleaning, tissue debridement, and exercises by the physical therapist.	Not known.	Immersive virtual reality dome projection screen developed by CobraSimulation.	Game called Bubbles1; interactive pseudo-3D projector dome VR videogame where bubbles are generated by squeezing a waterproof pear-shaped mouse or by an automatic mode.	Middle level.	May be effective. No side effects were reported in either group.
Virtual Reality for Pediatric Needle Procedural Pain: Two Randomized Clinical Trials	E. Chan et al. 2019	Tertiary hospital inpatient and outpatient clinics	4 - 11	**Pain management** during venipuncture and intravenous cannulation.	Not known.	VR headset. Google Daydream goggles and Google Pixel XL smartphone.	Game; interactive underwater adventure beginning with relaxation and progressing to marine scenes. The child interacted with the environment (eg, virtual fish) through gaze-based tracking.	Middle level.	Effective. Significantly reduced pain, anxiety, and distress. Only minor and rare adverse effects.
A Biofeedback Based Virtual Reality Game for Pediatric Population (BioVirtualPed): A Feasibility Trial	E. H. Savas et al., 2024	Hospital, pediatric oncology and hematology clinic.	7 - 12	**Pain, anxiety and fear management** during port needle insertion for oncology patients.	Not known.	VR headset. Oculus Quest 2, an accelerometer and respiratory sensors.	BioVirtualPed encourages practicing breathing techniques to be actively involved in the game.	Middle level.	Effective on pain management. No side effects.
The Effect of Virtual Reality Distraction and Fatigue Training on Anxiety and Fatigue Levels in Children with Cancer: A Randomized Controlled Study	G. Ö. Gerceker et al. 2024	Pediatric hematology and oncology wards at university hospitals.	6 - 17	**Anxiety and fatique management** at chemotherapy for cancer.	Not known.	VR headset. Oculus Quest 2.	Optional games: VR-rollercoaster, Ocean Rift, and yoga meditation. Patient able to move in the VR environment by turning head (left, right, up, down)	High.	Effective. Statistically significant reduction on pain, fatique and anxiety on days 1 to 3 compared to control group.
Immersive Virtual Reality Versus Video Distraction for the Management of Emergence Delirium in Children: A Randomized Controlled Study	H. Chen et al., 2022	Hospital surgical ward.	4 - 7	**Surgery induction**; distraction on elective surgical procedures within pediatric and oto-laryngology departments under general anesthesia.	Not known.	VR headset. PICO 4 Vision Pro	Optional videos..	Low, video only.	Effective in reducing postoperative pain but not anxiety. IVR is more effective in influencing postoperative behavioral outcomes compared with the combined approach of video distraction with parental presence.
Efficacy of smartphone active and passive virtual reality distraction vs standard care on burn pain among pediatric patients a randomized clinical trial	H. Xiang et al. 2021	Pediatric outpatient clinics.	6 - 17	**Pain management** with clinical burn care.	Not known.	VR headset, Apple iPhone 6 smartphone and detachable earphones.	Game called Virtual River Cruise; an otter floated a boat down a river, and players activated snow-blowing statues. Children played the VR game by tilting their head, minimizing interference with the dressing change.	Middle level.	Effective on reducing overall pain and worst pain scores. Also effective on reducing patient self-reported pain during burn dressing changes.
Golden Breath: Feasibility and acceptability of a biofeedback-based virtual reality game on reducing children's needle-related pain and fear	I. A. Aydos et al., 2024	Pediatric inpatients and outpatient clinics of university hospital, providing tertiary care.	4 - 12	**Pain and fear management** during needle insertions (venipunctures eg.).	Not known.	VR headset, a wired microphone, and a mobile device	Game called Golden Breath; controlled with inhale and exhale, which helps reduce fear by rechanneling the child's attention to VR environment and encouraging regulated breathing. The sounds of inhalation and exhalation captured by themicrophone are analyzed in real-timeusing Unity's built-in packages.	Middle level.	Effective in reducing pain and fear in children undergoing needle procedures. Pain level decreased over 50%. High satisfaction of users. No side effects.
"Doc McStuffins: Doctor for a Day" Virtual Reality (DocVR) for pediatric preoperative anxiety and satisfaction: Pediatric medical technology feasibility study	J. Gold et al., 2021	Hospital, ambulatory surgery center and the main operating room	6 - 18	Preoperative anxiety management, during **surgical preparations** on planned outpatient surgery preparation.	Not known.	VR headset.	Game or video; Disney's DocVR experience. In main experience user help Doc McStuffins treat toy patients in operation room by completing a series of VR tasks. Selection of Doc McStuffins episodes and clips may also bee chosen instead.	High.	Effective in reducing anxiety. A strong statistically significant decrease in anxiety. Patients reported less fear, and less time spent thinking about upcoming procedure.

Effectiveness of a virtual reality intervention to minimize pediatric stress and pain intensity during venipuncture	J. Piskorz & M. Czub 2018	Hospital, pediatric nephrology clinic.	8 - 14	**Pain management** during venipuncture.	Not known.	VR headset. Oculus Rift DK2.	Game based on Multiple Object Tracking (MOT); patient memorizes several briefly flashing elements and later tries to find them among other moving objects.	Middle level.	Effective. Stress levels were 73.4% lower in the VR group. Pain intensity was 59% lower in VR group.
Virtual Reality as a Non-Pharmacological Aid for Reducing Anxiety in Pediatric Dental Procedures	I. Trusculescu, et al. 2025	Dental clinic	6 - 12	Non- invasive dental procedures. **Anxiety and stress management** during dental appointment.	Not known.	VR headset. Kit Limbix VR model.	Animated cartoons such as SpongeBob SquarePants, Tom and Jerry, etc. Or immersive natural scenes, such as beaches, forests, or underwater environments, accompanied by soothing instrumental music.	Low, video only.	Significantly lower anxiety and puls levels with VR distraction compared to no distraction at all.
Take-Pause: Efficacy of mindfulness-based virtual reality as an intervention in the pediatric emergency department	M. Butt et al., 2021	Emergency department.	13 - 17	**Anxiety and pain management**	Kyllä.	Oculus Go headset and headphones	Application called Take-Pause; mindfulness exercise for 3 min period.	Low	Effective on reducing anxiety, no significant reduction of pain.
Virtual reality for distraction during painful procedures in pediatric surgery: A randomized clinical trial	M. Gerards et al., 2025	Hospital; pediatric surgery, and pediatric and adolescent urology wards.	5 - 16	**Pain and anxiety management** during insertion of PIC, surgical dressing change and the in-sertion and removal of transurethral catheters.	Not known.	VR headset. PICO 4, PICO Immersive Pte.	Relaxed or active 360° videos.	Low, 360-videos only.	Effective. VR reduced patient reported anxiety and pain during and after procedure.The duration of procedures has been statistically significant reduced with VR intervention.
Use of virtual reality in the reduction of pain after the administration of vaccines among children in primary care centers in Central Catalonia: Randomized clinical trial	M. Herrera et al., 2025	Primary care centers	3 - 6	**Pain and anxiety management** during vaccination.	Not known.	VR headset. Pico Interactive's Pico G2 VR goggles and AOYODKG Android tablet.	A first-person video called "NeedleCetamol/ Leia's World"; 2,5min long video is synchronized with the time of vaccine(s) delivery.	Low.	Effective in reducing pain and anxiety levels compared to those in the control group. More children experienced no pain at all compared to control group.
The effect of visual and/or auditory distraction techniques on children's pain, anxiety and medical fear in invasive procedures: A randomized controlled trial	N. Goktas & D. Avci, 2023	Pediatric emergency department on public hospital	7 - 12	**Pain, anxiety and medical fear management** during invasive procedures.	Not known.	VR headset: Zore G07E VR Shinecon 3D	The audio video named "The Spacewalker" in the "Within" mobile application. After the invasive procedure, the children continued to watch the virtual reality video until it finished.	Low.	Effective in reducing anxiety, pain levels and medical fear.
Virtual Reality Distraction Is No Better Than Simple Distraction Techniques for Reducing Pain and Anxiety During Pediatric Orthopaedic Outpatient Procedures: A Randomized Controlled Trial	P. Fabricant et al., 2023	Urban tertiary institution	4 - 14	**Pain management** during cast removal or percutaneous pin removal of orthopedic pediatric patients.	Not known.	VR headset. Oculus.	Game or video; patient is controlling the game via head motion or non-interactive video provided visual obstruction to the procedure with no patient interaction.	High or low.	As effective as other simple distraction techniques (such as tablet video viewing) on reducing procedural pain and patient reported pain and anxiety.
Virtual reality for intravenous placement in the emergency department—a randomized controlled trial	R. Goldman & A. Behboudi, 2021	Pediatric emergency department.	6 - 16	**Pain and anxiety management** during intravenous catheter insertion.	Not known.	VR headset. VOX+ Z3 3D Virtual Reality and Asus Zenfone 2 ZE551ML mobile device.	360° rollercoaster video and experience.	Low.	Effective in reducing pain as reported by children during and after procedure. Significantly lower level of pain reported. Satisfaction from anxiety management was rated significantly better in the VR group (median score 9 and 7 in VR and control groups, respectively, p < 0.007). No effect on anxiety level.
Virtual reality hypnosis for needle-related procedural pain and fear management in children: a non-inferiority randomized trial	S, van den Berg et al., 2023	Hospital	6 - 18	**Pain management** and **VR hypnosis** during needle procedures.	Not known.	VR headset. G2 VR from PICO	Not known. Insufficient description of the application. The script included an audio script, interactive modalities, and soothing background music.		As effect as standard care on pain and anxiety management.
Virtual Reality: Augmenting the Acute Pain Experience in Children.	S. Diaz-Hennessey, E. O'Shea & K. King, 2019	Emergency department at pediatric hospital.	8 - 17	**Pain management** in acute sicle cell or vaso-occlusive crisis.	Not known.	VR headset. Google Daydream.	Optional immersive mini games; ocean exploring, a car racing game, a 3D fishing adventure or a magical forest exploration experience.	High.	Not efficient on reducing pain. Effect din´t last after the end of use. May reduce the number of narcotic doses needed.
Decreasing Pain and Fear in Medical Procedures with a Pediatric Population (DREAM): A Pilot Randomized Within-Subject Trial	S. Le. May et al. 2021	Outpatient clinics, surgical-trauma unit of University hospital.	4 - 17	**Distraction** method for burn or fracture patients undergoing painful medical procedures.	Not known.	VR headset. Oculus Rift (consumer version).	Game called Dreamland; peaceful fantasy land which has been invaded by funny looking little creatures that are stealing all of the crystals. The player's role is to save the kingdom of Dreamland and retrieve all of the crystals.	Middle level.	Effective on reducing pain-related fear and discomfort. Also mildly reduced overall pain scores but no statistically signifficant difference to standard care.

Virtual reality during pediatric vascular access: A pragmatic, prospective randomized, controlled trial	T. Caruso et al., 2019	Pediatric hospital; preoperative center, interventional radiology suite, cancer center, short stay unit, and emergency department.	7 - 18	**Pain management** during peripheral intravenous catheter placement, phlebotomy, or port access.	Not known.	VR headset. GearVR and Samsung S7 or S8 mobile device.	Optional games; Ocean Rift (Picselica 2016), Pebbles the Penguin (Mighty Immersion 2016), or Space Pups (Mighty Immersion 2016). Nonviolent activities, such as collecting pebbles for points in Pebbles the Penguin, eating dog treats in Space Pups, or swimming underwater in Ocean Rift.	High.	No significant differences in postprocedure pain, postprocedure fear, or compliance between virtual reality and other unmedicated treatments. Children in the virtual reality group were satisfied with the intervention.
Use of Virtual Reality in the Pediatric Perioperative Setting and for Induction of Anesthesia: Mixed Methods Pilot Feasibility Study.	Y. Huang et al., 2025	Pediatric orthopedic university hospital	10 - 14	**Surgical preparation**; distraction method with elective surgery under general anestesia from waitingroom to surgery induction.	Not in use.	VR headset. Pico Neo 3	Game called DREAM (Paperplane Therapeutics, Inc); patients throwing red balls at balloons, diamonds, and trolls in a fantastical landscape.	Middle level.	Might be usable during surgery induction.