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Interaction Model for Child to Cope Stress Using Virtual Reality and Watching Video during Venipuncture in the Emergency Department: A Literature Review

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LITERATURE REVIEW

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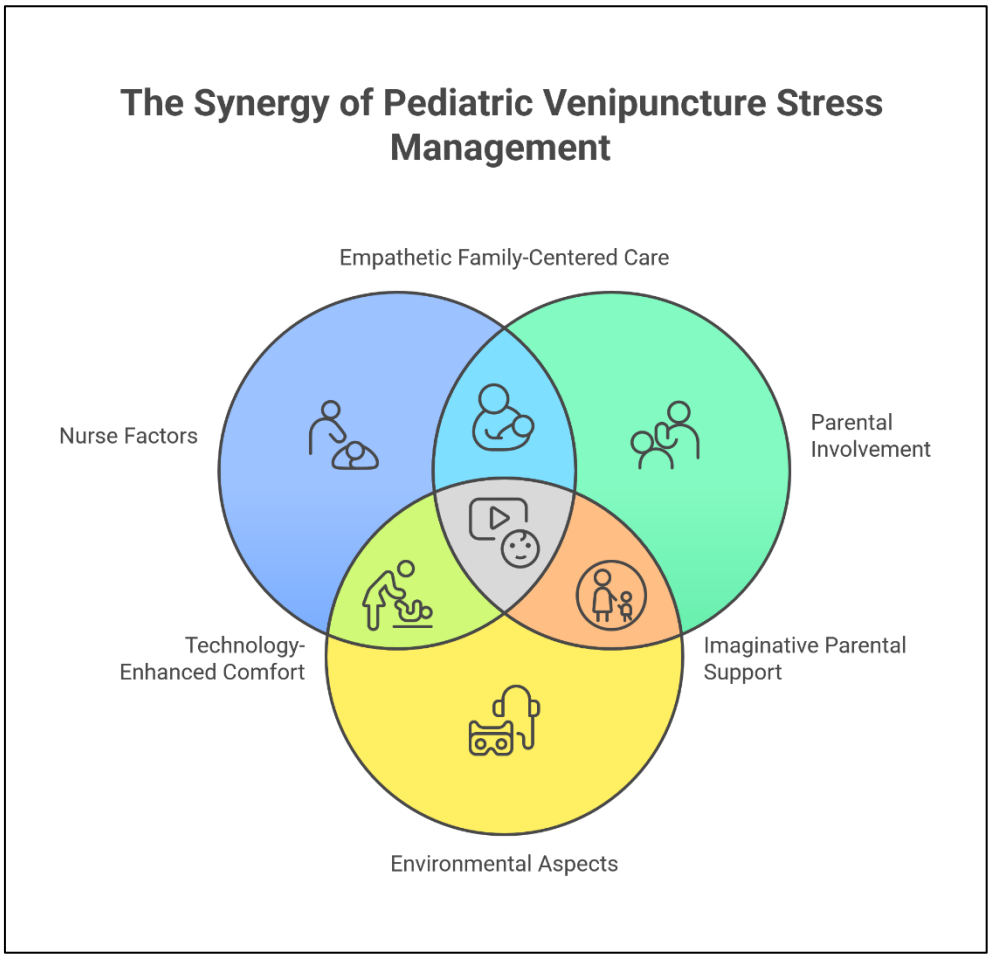
ABSTRACT

Venipuncture is the most painful and traumatic procedure often performed by nurses on pediatric patients. Innovation using technology-based interaction models is urgently needed in the emergency department. This study aims to determine the effectiveness of interaction models in reducing stress associated with venipuncture by utilizing virtual reality and video watching in the emergency department. This study employs a literature review, drawing on fourteen reputable articles from the ResearchGate, ScienceDirect, and SpringerLink databases. The results of the study based on the interaction model include (1) nurses must have a role in understanding children's stress, experience in managing children's stress, speed of completion of venipuncture procedures, and critical thinking in assessing the level of difficulty of venous access; (2) child attachment the with the importance of parental presence to suppress children's temperament; and (3) environmental aspects that support innovation in the use of virtual reality and watching videos as imaginative distraction techniques. The interaction model suggests that the roles of nurses, parental involvement, and environmental aspects can help manage the stress of children in pain in the emergency department.

Key Messages:

- Venipuncture is a procedure that involves puncturing a vein to draw blood and administer fluid therapy. It is often performed by nurses in the emergency department. This procedure is particularly painful for children because it causes psychological and physiological stress.
- Nurses, as providers of health care, must think critically about the biological, social, psychological, and spiritual aspects of pediatric patients to prevent stress from developing into trauma. Therefore, an Interaction Model is essential.

GRAPHICAL ABSTRACT



INTRODUCTION

It is undeniable that venipuncture is a stressful intervention because it is painful for hospitalized children (1). Stress is an ongoing psychobiological process with physical, emotional, mental, and behavioral aspects (2). These aspects influence each other, especially the painful action (2,3). This procedure is performed intentionally by inserting a needle through a vein to obtain a blood sample for laboratory testing and direct therapy (4). Various stress responses include 67% of children experiencing high anxiety before the procedure (5), 65% of children experiencing moderate to severe pain during the procedure (6), and 10%-11% of children experiencing phobias (7). Children perceive nurses as hurtful figures (9). Failure to perform the procedure occurs (33% to 69% of the time) (8).

If children experience prolonged stress, it can lead to chronic stress (7), which can affect their physical and mental growth (2). Nurses must be sensitive to address this problem by applying an interaction model (9). The application of the interaction model is a nursing concept that maintains children's mental health. This model emphasizes the importance of "interaction" between the nurse, the child, and the environment (9,10). This model was developed by Kathryn E. Barnard. It is straightforward and practical (11). This nursing model outlines the close relationship between healthcare providers' practices in evaluating children during care. This model combines the importance of the nurse as a protector, children's temperament, and the environment as a distraction through imagination by providing audiovisual distraction techniques in line with advances in digital and multimedia technology (11,12) during painful procedures.

However, there is little nursing literature on the application of the pediatric health assessment interaction model in this situation. This study aimed to determine the application of the interaction model to address stress due to venipuncture using virtual reality and video viewing in the emergency department.

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The specific objective was to determine effective interventions based on the pediatric health assessment interaction model in managing stress in children during venipuncture procedures in the emergency department.

METHODS

This research method uses a narrative literature review by carrying out the stages: research questions, searching the literature, analyzing literature, and presenting results (13). This research question follows the PICO guidelines as presented in Table 1. Simplified use of critical judgment in published articles and increased transparency.

Table 1. PICO Quidelines

Research Title	Interaction Model for Child to Cope use Virtual Reality and Watching Video during Venipuncture in the Emergency Department							
PICO questions	1. How does the interaction model to cope stress during venipuncture for pediatrics use virtual reality and watching video in the Emergency Department? 2. What are the effective interventions for the interaction model, virtual reality and watching video, to manage stress in children during venipuncture procedures in the Emergency Department?							
Research Topics Component		**P (POPULATION)**		**I (INTERVENTION)**		**C (COMPARISON)**		**O (OUTCOME)**
Key Term		"Children Given a Venipuncture in the Emergency Department"	AND	"Virtual Reality"	AND	"Watching video"	AND	"Stress"
Alternative Term	OR	Children with Blood Sampling in the Emergency Department	OR	VR	OR	Music Videos	OR	Cry
Alternative Term	OR	Pediatric Intravenous Insertion in the Hospital		-	OR	Cartoon Videos	OR	Relaxed
Alternative Term	OR	Installation of Infusion for Children in the Hospital		-	OR	Movie Videos	OR	Angry

Researchers used databases such as ResearchGate, ScienceDirect, and Springer Link to find the effectiveness of each distraction technique between virtual reality and watching video in children during venipuncture procedures in the emergency department. Before conducting a literature search, the research team established inclusion criteria, including reputable journals from 2018-2025 with randomized controlled trials (RCT) quantitative research methods, full text, English manuscripts discussing virtual reality interventions, and watching videos of venipuncture injection procedures in children in the hospital. Exclusion criteria included conference papers, symposiums, discussion papers, children with impaired consciousness, hearing and vision problems, research in dental care, literature review, and systematic review. The researcher has described the filters in Figure 1. A total of 14 articles were included in the review.

Published manuscript search strategy: researchers used alternative terms as keywords, including population (P), intervention (I), comparison (C), and outcome (O), which are presented in Table 1. The articles retrieved from the database were catalogued using bibliographic management software, and then reviewed and classified.

After the description, the researcher adjusted according to the preferred reporting items for systematic review and flowchart meta-analysis (PRISMA) (14). General characteristics of selected articles were analysed based on year of publication, stress on children during venous puncture in the hospital,

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virtual reality, watching video, and study design to determine content, results, and effects. We reviewed the entire literature independently and integrated the results of our analyses. Interrogative discussions and studies resolved differences of opinion until an agreement was reached.

Table 2. Review the Journal

No	Author (s)	Respondent/ Age	Country/ Database	Aim	Result
			Virtual Reality		
1	Hsu et al., 2022 (21)	128 6 to12 years	Taiwan Science Direct	Reduces the child's pain and fear	The ability of nurses to assess pain response is 1.13 ± 1.51 p < 0.001, shorter vein puncture time (seconds) 53.50 ± 19.01, p = 046 and the average work experience of registered nurses 6.58 (± 5.41) years, p=015 reduced the risk of failure of venous access puncture. Effective in reducing pain (WBFPS (p= 0.028)) and fear (CFS (p= 0.004))
2	Goldman & Behboudi, 2021 (22)	66 6 to 16 years	Canada Springer Link	Know the intensity of pain	Effective in reducing pain (FPS-R (p < 0.024)) and anxiety (Venham Situational Anxiety score (p <0,007)
3	Gerçeker et al., 2021(23)	42 6 to17 years	Turkey Science Direct	Reduce pain, fear, and anxiety when vein puncture chemotherapy	Effective in reducing pain (WBFPS (p < 0.001)), fear (CFS (p<0.001)), and anxiety (CAM-S (p < 0.001))
4	Gold et al., 2021(24)	118 10 to 18 years	United States Research Gate	Reduce pain and anxiety in children during peripheral intravenous catheter (PIVC) placement.	Caregiver-reported ability (1.87 points [95% CI, 0.99-2.76 points]; p= 0.04. Effective in reducing post-PIVC anxiety (FPS-R (p = 0.002)), and pain (VAS (p < 0.001))
5	Erdogan & Ozdemir, 2021(25)	142 7 to12 years	Turkey Science Direct	Reducing pain and fear	Effective in reducing pain, and fear VR compared to standard therapy: VAS (p=0.001); WBFPS (p<0.001); and CFS (p<0.001)
6	İnangil et al., 2020 (26)	120 7 to 12 years	Turkey Science Direct	Efficacy of watching cartoons with the VR box group and tablet group	6 years of experience in pediatric nursing. Effective in reducing pain (WBFPS (p<0.001)) VR box than a tablet, and fear (CFS (p<0.001)) VR box than a tablet
7	Chan et al., 2019 (27)	124 4 to 11 years	Australia Research Gate	Efficacy and safety of virtual reality	The ability of caregiver-reported median distress in both ED p = 0.020 and pathology p = 0.004). Effective in reducing pain (FPS-R (p = 0.018)), and anxiety (visual analogue thermometer anxiety score (p = 0.034)).
8	Chen et al., 2019 (28)	136 7 to 12 years	Taiwan Research Gate	Reduce the pain and fear during the vein puncture procedure	Nurse work experience (years) 7.4 ± 7.0 and length of time of stabbing (seconds) 53.5 ± 19.0, p = 0.046 and reported pain p = 0.006. Effective in reducing pain (WBFPS (p = 0.031)); fear (CFS (p = 0.043)); and time required was shorter (p = 0.046)
			Watching Videos		
9	Ugucu et al., 2022 (29)	56 6–8years	Turkey Science Direct	Reduce pain, anxiety, and fear during venipuncture procedures	Effective in reducing pain (WBFPS (p=0.013)); fear (CSAS (p=0.023)); and anxiety (CFS (p=0.008)) when watching cartoons than blowing bubbles

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No	Author (s)	Respondent/ Age	Country/ Database	Aim	Result
10	Koc Ozkan et al., 2021 (30)	92 4 to 10 years	Turkey Research Gate	Reduce anxiety and fear in children	Effective in reducing fear (CSAS (p=0.001)) and anxiety (CFS (p=0.001)) using watching cartoons compared to standard therapy
11	Düzkaya et al., 2021 (31)	477 6 to 12 years	Turkey Research Gate	Reduce pain and fear	Observation of fear observed by nurses p = 0.001. Effective in reducing pain (WBFPS (p=0.001; p=0.001)), and fear (CFS (p=0.001; p=0.001)) using information video groups, watching cartoons, and standard therapy
12	Inan & Inal, 2019 (32)	180 6 to 10 years	Turkey Research Gate	Reduce pain and fear	Effective in reducing pain (WBFPS (p = 0.003) and parenteral interactions (p = 0.019)), and fear (CFS (p = 0.001) when watching cartoons more effectively (p = 0.001) than parenteral interactions (p = 0.007).
13	Bergomi et al., 2018 (33)	150 5 to 12 years	Italy Science Direct	Comparison of pain and anxiety	Effective in reducing pain (WBFPS (p=0.02)), and emotions using watching cartoons (CEMS (p=0.02)).
14	Kuo et al., 2018 (5)	282 3 to 7 years	Taiwan Research Gate	Reduce the stress during the vein puncture procedure	It takes 6.3 to 9.3 minutes to complete the procedure, p < 0.001. Effective Observational Scale of Behavioral Distress–Revised (OSBD-R (p<0.001)); more effective for children aged 4 to 5 years (p = 0.004) than for children aged 5-7 years (p = 0.04)

This study comprised fourteen studies, and the results are presented in the following section. The results of the integrative literature review are presented in order of general characteristics of the literature, content, and format, the importance of parental presence, nurses' experiences, venipuncture procedures, the effects of VR device distraction techniques, and the effects of watching videos on tablets on stress in children.

RESULTS

Based on article screening, it is known that fifteen articles were published in the last seven years (2018-2025) and reviewed using randomized controlled trials. All selected articles consist of eight that discuss virtual reality and seven that discuss watching videos. This article is from Canada, the United States of America, Australia, Italy, Taiwan, and Turkey. The age range of children who received virtual reality interventions and watched videos, namely pre-school age children (age 3 to less than 6 years) to school age (age 6 to less than 13 years) there were five articles (37.5%), school age (age 6 to less from 13 years) there were six articles (43.75%), and school age (age 6 to less than 13 years) to adolescent age (age 13 to 18 years) there were three articles (18.75%). All selected articles used a physiological and psychological stress measurement scale for the effectiveness of each intervention during the venipuncture procedure.

All articles describe the successful administration of virtual reality and watching video during the venipuncture procedure in the hospital. Researchers analyzed the application of the interaction model to deal with stress in children. From the entire article, there are "interactions," namely: (1) the performance of nurses, (2) the importance of parental presence, and (3) environmental support with the availability of virtual reality interventions and watching videos.

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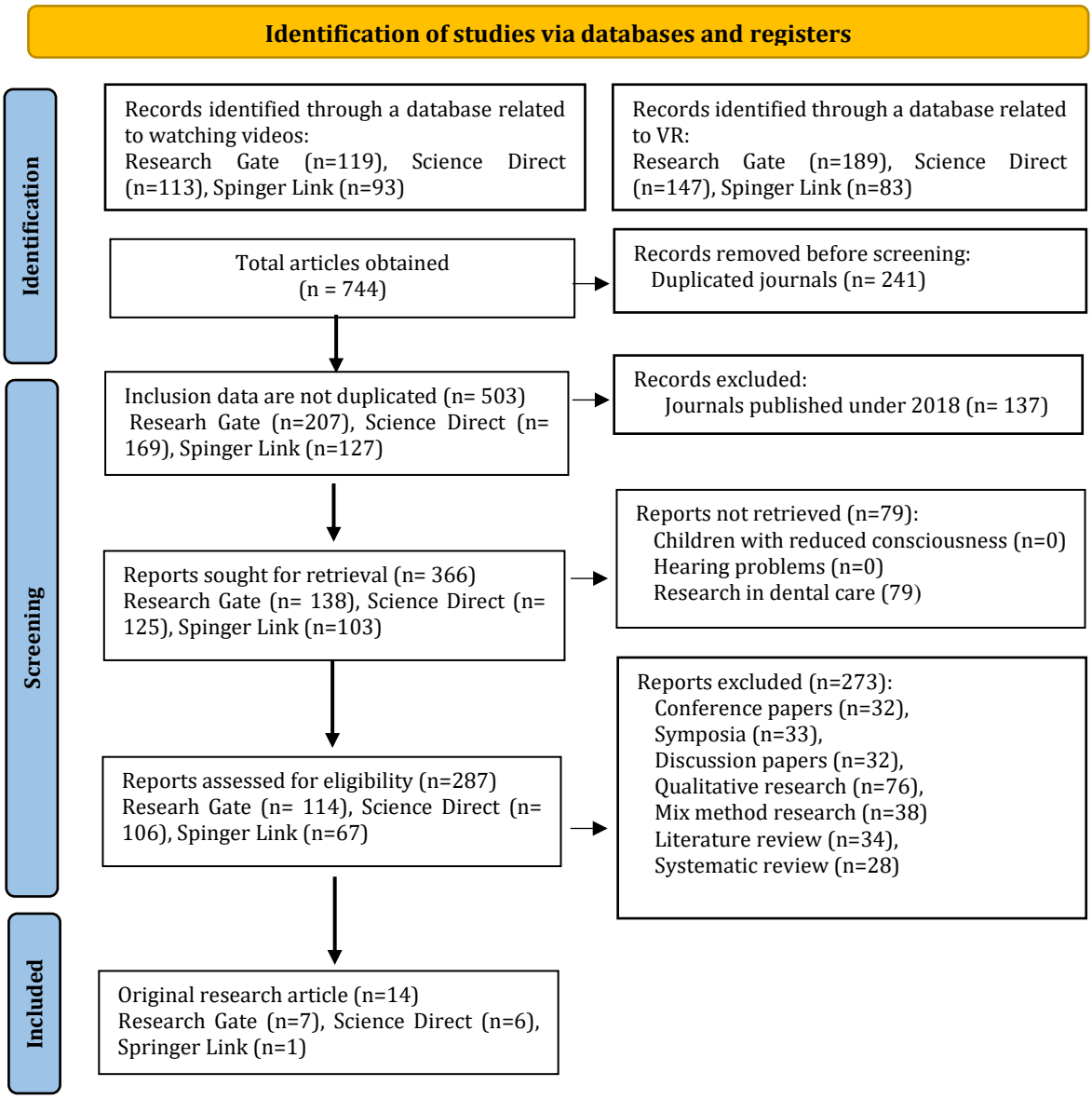

Figure 1. PRISMA 2020 flowchart steps in the process of selecting the articles used for review

The Performance of Nurses

All articles explained that nurses carried out the procedure for vein puncture in children. In addition, it was found there were five articles (35,7%) of all articles, nurses assessed stress in children physiologically and psychologically. It was found there were three articles (18.75%) of all articles explained that the longer the nurse's working experience when carrying out the vein puncture procedure, the more skilled the nurse, the better the sensitivity of the procedure's success and the ability to reduce the risk of procedure failure.

In addition, there were six articles (43,75%) of all articles described the nurse's work experience as directly proportional to the speed at which the nurse performs the vein puncture procedure. It was found that in there were three articles 20% of all articles, nurses with more than five years of work experience need less than 1 minute to carry out the vein puncture procedure, and the total time required, from the availability of equipment preparation to tidying up the patient after the puncture has completed a minimum of 8 minutes and a maximum of 10 minutes. It was found there were seven articles (50.1%) of the articles explained that the patient respondents had experience with the venipuncture procedure. As many as there were five articles (35.7%) of all articles described the failure of the venipuncture procedure

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with more than one puncture with the intervention of watching cartoon videos . It was found that only there were two articles (14.2%) of all articles discussed the DIVA score.

The importance of the presence of parents

The review results showed there were eleven articles (71.4%) of the articles included parents who were present with the patient to accompany and assess the child's response during the venipuncture procedure in the hospital. As much as three articles (28.5%) of all articles explain that the presence of parents is the implementation of atraumatic nursing in children. In addition, three out of eight articles were found explaining virtual reality that the role of parents is also to be someone the child can trust, especially if using a virtual reality tool is not scary and painful.

Environmental support with the availability of virtual reality interventions and watching videos during venipuncture procedures

Overall, it is known eight articles (57.1%) discuss the effectiveness of virtual reality, and six articles (42.9%)discuss the effectiveness of watching videos. Researchers found there were three articles 21.4% of all articles comparing virtual reality and watching videos said virtual reality was much more effective. It is known there were six articles (75%) of the eight articles discussing virtual reality are school-age children (6 to less than 13 years) and youth (13 to 18 years). While all articles discussed the effectiveness of watching videos, the ages of the respondents dominated by preschool-age children (3 to less than 6 years) and school-age children (6 to less than 13 years). The difference in the age range of the respondents in this study certainly affected the effectiveness of each intervention. It was found five articles (35,7%) of all articles explained that preschoolers prefer watching videos. Meanwhile, eight articles (57.1%) of all articles, school-age children and adolescents prefer virtual reality to deal with stress during venipuncture procedures. In addition, we can see the advantages and disadvantages of each intervention in Table 3.

Table 3. Advantages and disadvantages of virtual reality and watching videos in children

No	Type of Action / Characteristics	Virtual Reality	Watching Video
1	Advantages	1. It is the most effective distraction technique that can be given to children from preschool age (21,22,24,28) 2. It can help manage stress physiologically and psychologically (21,25–28) 3. It prevents children from becoming temperamental (21,26). 4. It makes children feel comfortable and immersed in the virtual world (21). 5. Nurses can administer it even if the DIVA score is high (27) 6. It can be given to children undergoing chemotherapy (23) .	1. Simple and inexpensive, requiring only animated videos and a smartphone or tablet (30) . 2. Suitable for children aged toddlers (5).
2	Disadvantages	1. Requires virtual glasses, a smartphone, 3D video, and an internet connection (if needed)(21,22) 2. Toddlers may be frightened by the closed-eye condition of virtual glasses(25,28) 3. Cannot be given to children with visual impairments (21,25,27,28)	1. Easily distracted during venipuncture (32). 2. Children cry easily because they can still see the venipuncture (31) 3. Can only be performed by nurses with a low DIVA score (29). 4. Risk of venipuncture failure because the child can still pull their hand away (33). 5. The child may still feel pain (30). 6. Cannot be administered to children with visual impairments (5)

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DISCUSSION

This study was conducted to provide useful data for implementing interaction stress management during venipuncture procedures in the emergency department. In Indonesia, no research literature analyzes the Interaction Model development that focuses on interaction (9). This model becomes a circadian rhythm and explores the emotional coregulation mechanisms of nurses, parents-children, and their environment (9). Kathryn E. Barnard is a researcher, educator, and consultant active in nursing who studies children, focusing on methods for evaluating child growth and development, mother-child relationships, the role of nurses as healthcare providers, and how the environment influences child development to overcome problems faced. This related cycle is the basis for the formation of the interaction model (10).

Nurse performance as a caregiver

Nurses' experience working in hospitals is essential (15,25). Nurses with little experience since graduation have a higher risk of puncture failure, whereas field nurses in hospitals with more experience have fewer procedure failures (16). Regarding the success of venipuncture procedures, experienced nurses have intuitive "knowledge", often challenging to explain to others, about the area of the vein to be injected, which is technically proven (15). In addition, the nurse's approach to the child is also an important component (22). The nurse's sensitivity in meeting the needs and knowing the patient's stress response is an added value that is always worth learn and understanding. Providing explanations and comfort to children is a key factor in supporting their success. The existence of a trusting relationship is the key to success and is a driving force to change the child's perception that the nurse is not the person who hurts him (28).

All articles reviewed stated that the vein puncture procedure was the most painful for children (15). All articles also explain that all vein puncture procedures are in accordance with applicable regulations and have been determined by the relevant hospital (28,29). We need to know that inserting an intravenous catheter is challenging and complicated in pediatric patients. If the diameter of the blood vessels is smaller, the visibility of the veins is reduced, and the veins are difficult to feel (6).

The younger the child, the lower the success of the intravenous catheter. This procedure's failure must be considered (6). Therefore it is necessary to assess to reduce the risk of failure. The failure of the procedure automatically increases the stress on the child, and trauma is inevitable (15,30). Therefore, in addition to carrying out the vein puncture procedure, researchers saw several articles, including assessing vascular difficulty or the DIVA score (31). The DIVA score is an assessment to determine the difficulty level of the venipuncture procedure (21). The components of the DIVA Score assessment include visual appearance, palpable appearance, history of difficult access, and extenuating factors. The total rating of the DIVA score is categorized as a value of 0 to 3, which is a low risk, so obtaining IV access; categories 4 to 5 are a moderate risk, so getting access with a competent practitioner; and +6 is a high risk so you need to consider emergency intervention central venous catheter (CVC) or intraosseous (IO) (21).The greater the score, the higher the level of difficulty because the more puncture attempts, the more physical and emotional pressure on the child, which can have a negative impact on subsequent procedures (15).

The importance of the presence of parents overcomes the child's temperament

The role of parents is very important in the success of the venipuncture procedure. When the child is in the hospital, the child will feel a loss of independence and be abandoned by the closest people, namely parents(15,22). Not without reason. This is not always caused by the anxiety that arises from the child but also the anxiety of the parents who want to accompany their child when he is sick and be present in every moment of the child's life (15,32). Unlike the research conducted by Cunha et al. (2018) and Moline et al., (2021), the relevance of the presence of parents depends on specific behaviors. Parents can indeed reduce but simultaneously increase the child's distress. Distress in children occurs because of parental behavior as predictors, such as scolding children, blaming children, and feeling their children are troublesome. Significantly the failure of this procedure is significant. The role of parents during this procedure also depends on their level of knowledge, education, and closeness (15). Good parental understanding will

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guide and explain to the child the purpose of the procedure so that the child becomes cooperative. In addition, with the closeness between parents and children, the child's trust becomes a strategy for nurses to establish a trusting relationship (27,34).

The attitude of parents and nurses who look unified makes children unknowingly think of nurses as good friends of parents who will help them with their problems. Given children's perception when in the hospital, they will feel far from family members, which is an incorrect assumption (11). Therefore, the most important responsibility of a nurse besides promoting health levels includes family empowerment and family education with the influence of family-centered empowerment models on knowledge and performance of care as the application of family center care (9). The goal is to avoid the negative impact on family members from decreased self-esteem and increased stress (35). Many hospitals still need to develop this concept. Closeness and trust in the child are important keys to the success of any invasive procedure (15).

Virtual reality and watching video effects as an environment

It is undeniable that the venipuncture procedure has made children feel physiologically and psychologically stressed to the point of causing phobias (15). Providing audiovisual interventions with virtual reality and watching videos distracts the patient from things that make him uncomfortable, anxious, or afraid (22). The way these interventions work has similarities in inhibiting the work of the sympathetic nervous system and neurotransmitter production to suppress signs of anxiety, so that children behave cooperatively (28).

. The way virtual reality works begins with using virtual reality glasses that cover the entire view of the respondent. In addition, this tool provides an attractive appearance. Virtual reality creates artificial stimuli that include visual images and spatial sounds that the user responds to and are designed to modify the virtual environment and create a sense of "presence" in the virtual world (15). Based on developments in psychology, virtual reality is a multifaceted technology that creates immersive, simulated, or both environments, thus becoming a therapy for addressing physiological (pain) and psychological (anxiety and fear) stress (15,16) and even phobias. This is because brain development at this age is characterized by increased neuroplasticity, heightened intensity, emotional reactivity, enhanced learning ability, and increased curiosity. (15,16). Respondents who received the intervention watched the video only by averting their eyes from the venipuncture procedure. However, respondents still felt physiological (pain) and psychological stress (anxiety and fear) even though it was reduced (23,24). The effectiveness of virtual reality is superior to watching videos, particularly among respondents of a certain age.

The effectiveness of virtual reality interventions can reduce physiological stress (pain) and psychological stress (anxiety and fear) even though the child is in the emergency department (36). This is because brain development at this age is characterized by increased neuroplasticity, intensity, emotional reactivity, increased learning ability, and curiosity (15). In contrast to toddlers and preschoolers not interested in virtual reality interventions. In addition to the development of thinking brains that are not the same as school-age children, ignorance of virtual reality causes them to believe that virtual reality glasses are objects that can hurt them. Especially in children who have never used virtual reality (37). Its unattractive shape makes children of this age uninterested. Therefore, alternative interventions to reduce physiological stress (pain) and psychological stress (anxiety and fear) can be given, namely watching videos during the venipuncture procedure in the emergency department (4,25,27).

The implication of the Interaction Theory of Child Health Assessment is beneficial in clinical practice as an intervention to reduce physiological and psychological stress. Nurses should know that the child's stress associated with the venipuncture procedure must be managed better to prevent trauma and involve parents and the environment as innovations in providing virtual reality and watching videos.

This study has limitations because it is only a literature review, and only a few data searches were obtained. It is hoped that direct research can be carried out on children coping with stress using the child health assessment model in the emergency department.

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CONCLUSION

The use of an interaction model that incorporates the role of the nurse, the parent-child relationship, and the environment, including virtual reality and watching videos of children in the emergency department during venipuncture procedures, has been shown to effectively reduce stress in children when tailored to their age. The interaction model is a strategy to improve the quality of healthcare services by reducing physiological and psychological stress.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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