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THE EFFECT OF VIRTUAL REALITY ON PAIN AND ANXIETY DURING BLOOD DRAW IN CHILDREN: A RANDOMIZED CONTROLLED STUDY

ÇOCUKLARDA KAN ALMA İŞLEMİ SIRASINDA UYGULANAN SANAL GERÇEKLİĞİN AĞRI VE ANKSİYETE ÜZERİNE ETKİSİ: RANDOMİZE KONTROLLÜ BİR ÇALIŞMA

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ABSTRACT

Objective: The study was carried out to determine the effect of virtual reality applied during blood draw upon pain and anxiety in children aged 5-12.

Methods: In this randomized controlled study, children included in the sample group were assigned to the control group (n=43) and Aquarium VR group (n=45) using block randomization. "Child State Anxiety Scale" and "Wong-Baker Faces Pain Scale" were used to collect the data of the study. Children in the Aquarium VR group watched the "Aquarium VR" application through virtual reality glasses during the procedure. The children in the control group benefited from routine nursing services. The pain scores after blood draw and anxiety scores before and during blood draw in children in both groups were interpreted.

Results: According to the self-report of the children and reports of the parents, nurse and researcher, the average pain scores of the children in the Aquarium VR group were found to be significantly lower rather than the ones in the control group ($p<0.05$). Although there was no significant difference between the anxiety score averages of the Aquarium VR and control groups before the procedure ($p>0.05$), the anxiety score averages of the children in the Aquarium VR group during the procedure were determined to be significantly lower rather than the ones in the control group ($p<0.05$).

Conclusion: VR was determined to be an efficient non-pharmacological method in decreasing procedural pain and anxiety in children during the blood draw procedure

Keywords: Anxiety, Blood Draw, Child, Nursing, Pain, Virtual Reality.

ÖZET

Amaç: Araştırma 5-12 yaş grubu çocuklarda kan alma işlemi sırasında uygulanan sanal gerçekliğin ağrı ve anksiyete üzerine etkisini belirlemek amacıyla yapıldı.

Gereç ve Yöntem: Randomize kontrollü bu araştırmada, örneklem grubuna alınan çocuklar bloklu randomizasyon kullanılarak kontrol grubuna (n=43) ve Aquarium VR grubuna (n=45) atandı. Araştırma verilerinin toplanmasında "Çocuk Anksiyete Skalası- Durumluluk" ve "Wong-Baker Yüzler Ağrı Ölçeği" kullanıldı. Aquarium VR grubundaki çocuklara işlem süresince sanal gerçeklik gözlüğünden "Aquarium VR" uygulaması izletildi. Kontrol grubundaki çocuklar ise rutin hemşirelik hizmetlerinden faydalandı. Her iki gruptaki çocukların kan alımından sonraki ağrı puanları ve kan alımından önceki ve esnasındaki anksiyete puanları değerlendirildi.

Bulgular: Çocukların öz bildirimine, ebeveyn, hemşire ve araştırmacının raporuna göre Aquarium VR grubundaki çocukların ağrı puan ortalamaları kontrol grubuna göre anlamlı derecede daha düşük bulundu ($p<0.05$). Anksiyete puan ortalamaları ise işlem öncesi Aquarium VR ve kontrol grupları arasında anlamlı bir fark olmamakla birlikte ($p>0.05$), işlem esnasında Aquarium VR grubundaki çocukların anksiyete puan ortalamalarının kontrol grubuna göre anlamlı derecede daha düşük olduğu belirlendi ($p<0.05$).

Sonuç: VR, kan alma işlemi sırasında çocuklarda işleme bağlı ağrı ve anksiyeteyi azaltmada etkili bir farmakolojik olmayan yöntem olduğu saptandı.

Anahtar Kelimeler: Ağrı, Anksiyete, Çocuk, Hemşirelik, Kan Alma, Sanal Gerçeklik.

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INTRODUCTION

Medical procedures refer to negative experiences that cause pain, distress, and anxiety for children. Blood draw as the most common medical procedure routinely requested by doctors is the one that children fear the most and makes them feel most anxious (Bergomi et al., 2018; Oulton et al., 2018). Besides causing excessive and unnecessary suffering, these procedures are possible to have long-term negative effects upon child health and development and treatment outcomes (Nordgård and Låg, 2021). Children exhibit behaviors such as crying, screaming, bending their body and muscle stiffness during the procedure (Chen et al., 2020). Especially in children, these feelings not only seriously affect the level of comfort during medical procedures, but also lead to negative consequences such as attempting to escape, causing negative effects in healing process, eating and sleeping disorders, and post-traumatic stress symptoms (Eijlers et al., 2019; Meentken et al., 2017).

Both pharmacological and non-pharmacological methods have been used to relieve pain in clinical environments (Toledo del Castillo et al., 2019). However, although pharmacological methods are possible to relieve pain quickly, they are time-consuming because physicians must examine patients, write prescriptions, and nurses prepare medications (Chen et al., 2020). On the other hand, non-pharmacological methods are generally easy to use, inexpensive, have few side effects and do not include physician evaluations, and nurses can apply them to patients using their nursing knowledge and skills (Chen et al., 2020; Koç Özkan and Polat, 2020). Non-pharmacological methods are not only a pain-reducing treatment method, but also reduce anxiety and depression, nausea and vomiting, facilitates restful sleep, makes the patient feel good and increases the desire to participate in healing process (Tick et al., 2018).

Non-pharmacological methods vary depending on the child's age, developmental level, and type of procedure and are categorized under three groups. These are supportive, physical and cognitive or behavioral methods. Supportive methods refer to practices including psychosocial care of children such as reading a book or playing games. Physical methods include techniques such as cold application, massage, and transcutaneous electrical nerve stimulation. Cognitive or behavioral methods include applications such as listening to music, daydreaming, relaxation and distraction with various methods (İnal and Canbulat, 2015; Khadra et al., 2018; Toledo del Castillo et al., 2019). Distraction method as one of these techniques is the most economical, safe, easy to manage and indicates the most efficient option reducing anxiety and disturbing behaviors in pediatric patients (Al-Nerabieah et al., 2020; Ka et al., 2018). Hospital clowns, watching cartoons, playing video games, using kaleidoscope and using virtual reality (VR) glasses refer to some methods used to distract attention (Koç Özkan and Polat, 2020).

VR as one of the methods of distraction is a new technological application that encourages distraction and allows users to dive into a virtual environment with three-dimensional vision and interaction through movements. This interaction is performed using a helmet, goggles, gloves, control and even voice command enabling patients to enjoy the feeling of being, moving and living in a virtual environment in real time (Nordgård and Låg, 2021; Scapin et al., 2017). There have been various studies revealing that VR is efficient upon reducing pain and anxiety perceptions in children in wound care, preoperative anxiety, chemotherapy, port access, chronic pain treatment, dentistry and routine medical practices (Bozdogan et al., 2021; Gold and Mahrer, 2018; Hoffman et al., 2001; Kerimoglu et al., 2013; Sander Wint et al., 2002; Toledo del Castillo et al., 2019). Although these studies have reported that VR is possible to be used in pediatric procedures, further researches are needed related to its possible use in different types of procedures and age groups (Özalp Gerçeker et al., 2020). For this reason, this study was carried out to determine the effect of virtual reality applied during the blood draw procedure upon pain and anxiety in children aged between 5-12.

H0: Virtual reality applied during bloodletting has no effect on children's anxiety and pain levels.

H1: Virtual reality applied during bloodletting has an effect on children's anxiety and pain levels.

MATERIALS AND METHODS

This study in randomized controlled design was carried out with children aged between 5-12 in Pediatric Polyclinic blood draw unit of the University Hospital in a province in Turkey between 15 May and 31 July 2021. The population of the study consisted of children who applied to the Pediatric Polyclinic blood collection unit of the hospital between the specified dates. The sample of the study, on the other hand, was calculated by taking into account the pre-test anxiety score averages of the intervention and

control groups in the study of Gerçeker et al. As a result of the evaluations, it was calculated as d=0.99 (high effect size), power=0.95, α=0.05 in the G*Power 3.1.9.2 statistical program. Accordingly, it was determined that the minimum number of children to be included in the study was 28 for the intervention group and 28 for the control group, a total of 56 children. The study included children aged 5-12 years, who did not have communication barriers, did not have pain before the procedure and did not have a chronic disease that would cause pain, blood was taken from the antecubital region and volunteered to participate in the study. Children who did not volunteer to participate in the study, who were visually impaired and who wore glasses were excluded from the study. Between these dates, 45 patients were included in the experimental group and 43 patients in the control group, who met the research criteria and volunteered to participate in the research, and the study was completed with a total of 88 patients.

Randomization

The children were included in groups randomly. "Stratification and block randomization methods" were used in the study for assigning the participants to the control and study groups. It was reported in the literature that the variables of age, gender, and interventional procedure experience were among the factors affecting the pain and anxiety experienced by children during interventional procedures. In this sense, the children were stratified as "female and male" for the gender variable and "5-8 years and 9-12 years" for the age variable, and block randomization was performed. In order to prevent the groups from being influenced by each other, data of the study group were collected in one day and the control group in the other. Data collection days of the study and control groups were determined with the method of drawing lots. This cycle was continued until sufficient sample size was obtained.

Data Collection Tools

Question Form

In this section, there are 6 questions about the descriptive characteristics of the children (age, gender, education level of the mother, education level of the father, time of the last blood collection, which parent was with the child during the blood collection process).

Wong Baker Faces Pain Scale-WBFPS

Developed by Wong and Baker, this scale assessing the severity of pain is used in children aged 3-18 years (Wong and Baker 1988). Wong–Baker Faces Pain Rating Scale (WBS) is robust and often used in the Turkish population (Aydın and Özyazıcıoğlu, 2019; Gerçeker et al., 2018; Koç Özkan and Polat, 2020). In this scale, pain was scored for facial expressions according to numerical values, and the numerical rating of the scale varied between 0 and 10. Facial expressions ranging from smiling (0=very happy/no pain) to crying (10=most painful) indicated emotions. The severity of pain increased as the score obtained from the scale increased, and the severity decreased as the score decreased. The child was possible to tell the nurse about the pain experienced more accurately with the drawing illustrating what each of the different numbers on the pain scale indicated. This scale was a reliable measurement tool for the Turkish population (Tsao and Zeltzer, 2008).

Children's Fear Scale (CSAS)

The Children's Fear Scale (CFS) was developed by McMurtry, Noel, Chambers, and McGrath (2011) and adapted to Turkish by Gerçeker, Binay, et al. (2018). CFS was a thermometer-like scale with a light bulb at the bottom and horizontal upward lines at intervals. On the scale, the children were instructed as "Imagine all your anxious or frustrated feelings are in the bulb or bottom of the thermometer." "If you're a little worried or nervous, emotions can go a little upward on the thermometer. If you are very, very anxious or nervous, the emotions can go to the top. Put a line indicating how worried or angry you are on the thermometer." In order to measure state anxiety (CFS), the children were asked to mark what they felt "right now". Before filling in CFS, sequencing skills of the children were monitored. They were asked to count to ten, they were also asked to answer, "Which is bigger, seven or four?" The children who could not successfully complete these tasks or did not understand the instructions were not asked to fill in CFS. Subsequent to data collection, two members of the research team reviewed and scored CFS of the children. A transparent meter with increments of ½ point marked was placed above the rating of children, then the increment of ½ point was rounded to the nearest number. The score varied between 0 and 10 (Gerçeker et al., 2018).

Virtual Reality Headset

In the Aquarium VR group, virtual reality headset compatible with iPhone 7 (Apple) was used to distract attention. Before use, the headsets were tested on five children for face fit and visibility of the application used. Written and verbal consent of the children and their parents was obtained to test the headsets. The children who tested the headsets were not included into the study. The headset offered a soft and comfortable experience in contact with the skin due to its leather and pad covering. It also had a wide viewing angle and an optical zoom button. Due to its noise isolation function, it did not disturb anyone or make noise.

"Aquarium VR" Application

The application simulated a submarine journey to explore the inside of virtual aquarium. The aquarium included sharks, aquatic mammals, clown fish and much more. It also allowed children to learn more about marine life in the Pacific Ocean (Eon Reality, 2021).

Ethical Principles of the Research

In order to carry out the research, 14/03/2021 dated and 03/14 numbered ethics committee approval from the Human Research Ethics Committee and legal permissions from the Hospital Management were obtained. After informing the children participating in the study and their parents about the research, they were explained about being free to participate in or not, and their written and verbal consent was also obtained from the parents. The children who participated into the study and their parents were assured that their personal information would not be disclosed to others, would not be used anywhere else and they had right to withdraw from the study at any time they wanted.

Data Collection

The children included into the study and control groups and their families were primarily informed about the study by the researcher in the waiting room at the entrance of the pediatric outpatient clinic blood draw unit. The children who were in 5-12 age group, had no communication barriers, did not use glasses, had no pain before the procedure and did not have a chronic disease causing pain, and volunteered to participate into the study were included in the study. The "Informed Consent Form" was signed by the parents and children who met the criteria and agreed to participate into the study. The children were stratified as "female and male" for the gender variable and "5-8 years and 9-12 years" for the age variable, and block randomization was performed.

The children included into the study and control groups and their parents were asked to rate CSAS to assess their anxiety levels before and during blood draw, and WBFPS to determine the pain they felt in their arm during blood draw. Similarly, the nurse and researcher rated WBFPS and CSAS.

The children in the study group were shortly informed about using the virtual reality glasses before the procedure. When the children sat on the patient's chair for blood draw, they put on virtual reality glasses and 3D "Aquarium VR" application was started to be watched from the virtual reality glasses 1 minute before the blood draw procedure. At the same time, the nurse applied a tourniquet for blood draw from the child and determined the vein from which blood would be drawn from the antecubital region. The blood was drawn from the antecubital region by the same nurse by means of a vacuum blood draw tube and the process lasted for approximately 2-3 minutes. During this procedure, the children were asked not to remove their virtual reality glasses at all.

No interventional procedure was administered to the children in the control group. Blood was drawn from the antecubital region by the same nurse by means of a vacutainer. In both groups, parents were permitted to be with their children in the blood draw room during the procedure.

Data Analysis and Interpretation

SPSS 25.0 package software was used for statistical analysis of the data. Percentage, average, Simple t-test and One Way ANOVA analysis were used to interpret the data. The statistical level of significance was regarded to be 0.05 in all tests. In order to obtain statistical results, fit of the data to the normal distribution was interpreted using the Shao method. In this sense, the Skewness value was determined to be 0.139, the Kurtosis value was -2,027, and it was found to have a normal distribution between -3 and +3.

Limitation of the Study

The research had various limitations. The research has several limitations. First, the study was not double-blind as it was randomized into groups by the researcher himself. However, the pain and anxiety levels of the participants were scored by the participants, parents, nurse and researcher in order to reduce the bias of the research. Second, the participants, their parents, the nurse, and the researcher were not blinded to the assessment of pain and anxiety level. Third, the study was carried out from a single center. Fourth, carrying out the study in a single hospital limited the generalization of the research results.

RESULTS

The descriptive characteristics of the children and parents included in the study were presented in Table 1. It was determined in terms of the children in the Aquarium VR group that 55.6% were in 9-12 age group, 55.6% were female, 84.4% had previous hospital experience, 66.7% had the last blood draw time between 1-6 months, 82.2% were with their mothers during the blood draw process; and in terms of the parents, the average age of the parents was 37.68±5.72, 51.1% had 2 children, and 31.1% were primary and high school graduates. 62.8% of the children in the control group were in 5-8 age group, 51.2% were female, 88.4% had previous hospital experience, 74.4% had the last blood draw time between 1-6 months, and 81.4% were with their mothers during the blood draw process; it was determined that the average age of the parents was 37.37±6.00 years, 32.6% of them had 3 children and 32.6% of them were university graduates. Furthermore, as could be seen in Table 1; In terms of child and parent characteristics, the two groups were statistically similar to each other ($p>0.05$). In addition, as could be seen in Table 1, the two groups were statistically similar to each other in terms of child and parent characteristics ($p>0.05$).

Table 1. Descriptive Characteristics of Children and Parents

	Aquarium VR Group (n=45) n(%)	**Control Group (n=43) n(%)**	**x^2**	**p**
Children's Descriptive Characteristics				
Age (Year)				
5-8 Age	20(44.4)	27(62.8)	2.974	0.085
9-12 Age	25(55.6)	16(37.2)		
Gender				
Girl	25(55.6)	22(51.2)	0.171	0.680
Boy	20(44.4)	21(48.8)		
Child's previous hospital experience				
Yes	38(84.4)	38(88.4)	0.288	0.591
No	7(15.6)	5(11.6)		
Last blood draw time				
<1 Ay	15(33.3)	11(25.6)	0.635	0.426
1-6 Ay Arası	30(66.7)	32(74.4)		
Parent who is with the child during the blood draw				
Mother	37(82.2)	35(81.4)	0.010	0.920
Father	8(17.8)	8(18.6)		
Parent's Descriptive Characteristics	**X±SD**	**X±SD**		
Parent's Age	37.68±5.72	37.37±6.00		0.801
Number of Children				
1	6(13.3)	9(20.9)	4.307	0.230
2	23(51.1)	13(30.2)		
3	12(26.7)	14(32.6)		
4 and above	4(8.9)	7(16.3)		
Educational Status				
Primary school	14(31.1)	9(20.9)	2.363	0.501
Middle School	6(13.3)	9(20.9)		
High school	14(31.1)	11(25.6)		
University and Above	11(24.4)	14(32.6)		

When the pain score averages of the children reported by themselves, their parents, the nurse and the researcher were regarded, the difference between the pain scores of the two groups was found to be statistically significant (p<0.05) (Table 2).

Table 2. Comparison of Wong-Baker Faces Pain Scale Mean Scores by Groups

Procedural pain scores by WB-Faces	Aquarium VR Group (n=45)	Control Group (n=43)	Test value	p
	X±SD (Min-Max)	X±SD (Min-Max)		
Self –reported[a]	2.17±2.47(0-10)	5.11±3.58(0-10)	517.00	**0.000***
Parent- reported[b]	2.40±2.28(0-10)	6.09±3.29(0-10)	6.089	**0.000***
Nurse-reported[b]	2.57±1.98(0-8)	6.04±3.39(0-10)	5.819	**0.000***
Researcher-reported[b]	2.48±2.22(0-10)	6.74±3.32(0-10)	7.027	**0.000***

Abbreviations: VR, virtual reality; WB, Wong–Baker. *p<0.05, [a]Mann Whitney U [b]Simple t Test

When the pre- and post-procedural anxiety score averages of the children reported by themselves, their parents, the nurse and the researcher were regarded, it was determined that the difference between the two groups was not statistically significant before the procedure (p>0.05), whereas the difference was statistically significant during the procedure (p<0.05).

Table 3. Comparison of Child Fear Scale Mean Scores before and during the procedure according to the groups

	Aquarium VR Group (n=45)	Control Group (n=43)	Test value	p
	X±SD (Min-Max)	X±SD (Min-Max)		
CFS Scores				
Self -reported				
Before[a]	4.75±3.01(0-10)	4.90±3.16(0-10)	0.230	0.819
After[b]	0.88±1.86(0-10)	4.74±3.23(0-10)	209.00	**0.000***
Parent- reported				
Before[a]	4.77±2.87(0-10)	5.58±3.18(0-10)	1.243	0.217
After[b]	1.08±1.68(0-7)	4.69±2.98(0-10)	248.50	**0.000***
Nurse-reported				
Before[a]	4.97±2.30(1-10)	5.81±3.08(0-10)	1.438	0.155
After[b]	1.22±1.41(0-5)	4.27±3.45(0-10)	460.00	**0.000***
Researcher-reported				
Before[a]	4.77±2.31(1-9)	5.960±3.05(0-10)	1.435	0.155
After[b]	0.73±0.86(0-3)	5.00±3.14(0-10)	190.00	**0.000***

Abbreviations: VR, virtual reality; CFS: Children's Fear Scale *p<0.05 [a]Mann Whitney U [b]Simple t Test

DISCUSSION

Today, digital technology has changed the whole world both in health and lives of children, besides occupying a remarkable place in their daily lives (Binay and Yılmaz, 2021). With the improvements in technology, virtual reality has had many uses in care and treatment such as distracting attention especially in children, during the surgery, in the care of chronic diseases, and during, before and after medical surgical procedures. The use of VR in children has been used in nursing interventions such as vaccination, injection, blood draw, vascular access, other invasive procedures, burn wound care, dressing, as well as dental treatment or rehabilitation services; and it has been reported to be an efficient method for reducing pain, fear and anxiety (Binay and Yılmaz, 2021; Palaz et al., 2020; Panda, 2017)

When the pain score averages of children were regarded in the study, the difference in pain scores between the two groups was found to be statistically significant. There were various similar studies in the literature related to this finding. It was determined in a randomized controlled study that VR applied to reduce pain during blood draw in children aged between 7-12 years was an efficient method (Gerçeker et al., 2018). It was found that the pain levels felt by the children in the study group administered with VR application during the vascular access procedure were lower rather than the pain levels reported by the children in the control group (Aydın and Özyazıcıoğlu, 2019). In another study, VR was used during the painful procedure caused by the injector in the pediatric oncology clinic, and the decrease in the pain score of the intervention group was found to be significant when compared to the control group. It was revealed in this study that VR increased the ability of coping with painful

procedures in children (Nilsson et al., 2009). In another study, the effect of VR use on pain in children during primary molar tooth extraction was analyzed, and it was revealed that VR successfully reduced the perception of pain (Palaz et al., 2020). In another study, it was similarly determined that the use of VR in children who came for dental treatment decreased the pain score (Niharika et al., 2021). In a study carried out with cancer diagnosed adolescents, VR was used during the lumbar function procedure, and it was stated that the pain scores of the children in the experimental group were lower than the ones in the control group (Sander Wint et al., 2002). It was reported that the pain score of the study group administered with VR application during dressing change in pediatric patients hospitalized with burn treatment in Taiwan was lower (Chan et al., 2007). In another study, it was revealed that VR applied to reduce pain in children during cold application was efficient (Dahlquist et al., 2010). It was also reported that distracting the attention using VR during vascular access was an efficient method for reducing pain in children aged between 8-12 years (Gold and Mahrer, 2018). In line with such information in the literature, it was possible to consider that VR could be efficient upon reducing the level of pain distracting the attention of children during various procedures, and it could be in various different procedures.

When the pre- and post-procedure anxiety scores of the children were analyzed in the study, it was found that whereas the difference between the two groups was not statistically significant before the procedure, the difference during the procedure was statistically significant ($p<0.05$). It was stated in the literature that the use of VR in medical and surgical procedures was benefited as one of the non-pharmacological methods to reduce pain, fear, anxiety and discomfort. In a study administering VR during the blood draw procedure in children, VR was reported to be an efficient method in reducing the level of pain and anxiety during the procedure (Koç Özkan and Polat, 2020). VR applied during invasive procedures in children aged between 4-15 years was stated to be an effective method in reducing pain and anxiety (Toledo del Castillo et al., 2019). It was found that virtual reality glasses used during dental treatment reduced the level of anxiety in children (Niharika et al., 2019). It was also reported that VR applied in dental treatment in children aged between 4-6 years was an efficient method in reducing pain and anxiety (Asl Aminabadi et al., 2012). In another study, it was found that the use of VR while vaccinating children aged 6-7 years was efficient upon reducing pain and fear (Chan et al., 2007). It was also stated that VR applied during burn wound care in 4-12 age group was efficient for reducing pain, anxiety and stress (Brown et al., 2012). Moreover, in line with this information in the literature, it was noticed that the use of VR during many procedures administered to children reduced psychological conditions such as anxiety and stress and increased the cooperation of children during the procedure.

CONCLUSION

In conclusion, VR was found to be an efficient non-pharmacological method upon reducing proceduralpain and anxiety in children during the blood draw procedure.

In line with these results, integrating technological facilities into nursing care in preparation for or during medical procedures in clinics can be an effective and interesting method for children, especially in acute and chronic pediatric pain management, providing anxiety and comfort. In addition, future studies recommend virtual environments designed for the specific type of procedure and patient characteristics (ie age, gender, cognitive abilities). In addition, nurse researchers should be encouraged to develop new techniques using new technologies to dissipate anxiety.

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Author Contributions

Plan, design: GA, SK; **Material, methods and data collection**: GA; **Data analysis and comments:** GA, SK; **Writing and corrections:** GA, SK, AÇ.

Conflict of interest

We declare that there is no conflict of interest in this study.

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