



# Nurses Performance Regarding Peripheral Cannulation among Neonate Khartoum State Hospitals (2020-2021)

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## Abstract

**Background:** Peripheral intravenous cannula is most common vascular access device used to administer medication or fluid, cannulation may cause severe damage to small vein if the insertion not proper, therefore it need professional practitioner. The study aimed to assess nurses' performance regarding peripheral cannulation for neonate in Khartoum state Hospitals, Sudan, in 2020.

**Material and Methods:** Adescriptive cross sectional hospital based study design was used. Sample size consisted of 105 nurses; data collected using self- administered questionnaire and observational checklist, data analyzed by Statistical Package for Social Sciences (SPSS) uses standard deviation, T test mean and percentage Spearman correlation coefficient p value was less than 0.05. Ratability and validity of the scale was test by Cronbach's Alpha and Spearman-Brown Reliability Coefficients Performance total scores (n = 32)

**Results:** Showed that, (54.3%) of nurses were between 21-30 years, (67.6%) of nurses were master holders, (55.2%) of them attended training courses regarding neonatology. The mean of nurses' performance about hand hygiene was 90.0%. The mean of nurses' performance about use of Personal protective equipment was 96.6%. The mean of nurses' performance about skin preparation was 92.2%. (37.1%) of nurses succeed to insert cannula after more than 3 attempts, 31.4 insert it from the second time, 18.1% from the first time, (62.9%) of nurses did not recorded the data. The overall mean of nurses' compliance about peripheral cannulation was 68%

**Conclusion:** The studies concluded that nurse's performance regarding cannulation is high and there was lacking practice toward peripheral intravenous cannulation in some pediatric health settings and there is positive correlation between nurse's level of education and their performances. The study recommended more training courses.

**Keyword:** Nursing; Cannulation; Pediatric health

**Abbreviations:** PIVC: Peripheral Intravenous Catheters; PICC: Peripherally Inserted Central Catheter; SPSS: Statistical Package for Social Sciences.

## Introduction and Background

The neonatal period is the first four weeks subsequent to birth [1]. Some newborns require observation and care that

is beyond the scope of a normal newborn nursery, these are called high risk neonates [2]. Provides care to full spectrum of newborns ranging from extremely premature infants, to high-risk and critically ill babies, to less critically ill babies who are recovering and maturing with increased emphasis is being placed on the need for standards of care, as well as mechanisms which address the barriers to provision and use of quality care [3,4]. Cannulation in neonate is very difficult to be success from time and repetitive cannulation can lead to neonatal complication, repeated needle insertion attempts subject children to pain, stress, increased infection risk, and impact negatively on child.

Despite the known of complications of peripheral intravenous cannulation, there are nurses still not practicing the correct way of applying them [4-6].

### General Objectives

- To assess nurses' performance regarding Peripheral Intravenous Cannulation of neonate in Khartoum state.
- Specific objectives.
- To assess nurses performance regarding hand hygiene and personal protective equipment.
- To assess nurses performance regarding skin preparation.
- To study nurses performance regarding cannula access and insertion.

### Justification

- Repetitive cannulation can lead to adverse neonatal complication.
- There is mal practice regarding correct way of applying cannulation and there are no enough studies conducted regarding cannulation
- Thus this study will shed light on nursing performance regarding Peripheral Intravenous Cannulation.

### Literature Review

Peripheral intravenous catheters (PIVC) are venous access devices commonly used for drug or fluid administration, monitoring, and diagnostics, in pediatric patients, in hospitals worldwide [7-11]. It is estimated that nearly two billion peripheral intravenous catheters are used in hospitalized patients globally [11]. Despite the ubiquity and essential nature of PIVCs, they are not without complications. Rates of PIVC complications are reportedly high in studies in the pediatric population, ranging from 34 to 56% [12-14]. In comparison to PIVC complications in the adult population, which range from 20% to 32% [10,15,16].

Ensure the safety of infants is essential to providing

quality care. However, if on one hand care interventions seek to improve such assistance, on the other, the combination of processes, technologies, and human resources related to health care can become a risk factor for the appearance of errors and adverse events. Thus, it is necessary for nurses to know the indications for the PICC therapy, as it requires technical expertise, clinical judgment, and conscious, safe, and effective decision-making [17].

Central Venous Catheter insertion requires both experienced staff and the necessary equipment; it also requires knowledge about the benefits and risks of potential sites, using full sterile technique, ability to monitor the neonate during and after CVC insertion and knowledge about managing potential complications. And final a full documentation of procedure and any complications [18].

Installation of the PICC brings many benefits to the therapy of newborns, and prevents numerous complications, such as unnecessary punches. This type of catheter has been suggested as the most suitable for low levels of infections and complications when compared to other central vascular devices in both the insertions of the act, such as during maintenance and removal. It is a procedure that guarantees the NB a safe venous access for the infusion of irritating and/or vesicant medicaments, as previously stated, decreased pain caused by repeated venous punctures, and stress caused by excessive handling; therefore, this is imperative for the survival of the increasingly premature newborns [19].

PIVC complication and failure in pediatric patients is associated with increased morbidity. Re-insertion procedures are painful and anxiety-provoking for neonate as well as their parents [20]. Failure to obtain and maintain a patent peripheral intravenous access may also delay diagnostic and subsequent medical treatments [14]. Re-insertion attempts and premature PIVC removal consequently increase hospital costs, including not only expenses for PIVC devices but also for medical and/or nursing time.

PIVC related complications can also be costly for patients, not only in terms of patient experience and morbidity (e.g., pain, delayed treatment) but also for treatment-related out of pocket expenses in some healthcare systems [12]. Patients may need to stay in hospital for a longer period because of PIVC complications: this is particularly evident for catheter-related blood stream infections (CRBSI). Other studies have examined the incidence of PIVC failure and complications in the pediatric population [12,13].

The nursing protocol for inserting, handling/maintaining, and withdrawing the PICC becomes essential for the quality of care and the standard to be implemented in the health facility, preventing possible damage to the NB, and

ensuring the safety of the procedure and the autonomy of the team regarding neonatal care throughout the care process involving the catheter.

In this sense, nurses highlight the need for a daily record of care for the handling, maintenance and possible post-puncture interurrences, in order to prevent complications in the procedure, and also the construction of a specific protocol that can contribute to the everyday practice of those who are in charge of this procedure, directing nursing practice in terms of the use of this catheter, aiming primarily to standardize the conduct and improve the quality of care in the NICU, which becomes crucial for the success of this practice with the PICC [21].

Preparation of the newborn should be performed by the nurse before the procedure. These actions are performing a physical examination, analysis of laboratory exams and diagnostic imaging, cardiac and respiratory monitoring, restraining the newborn, analgesia and sedation.

Preparation of the nurse and material – include the priority of actions to be performed before the insertion procedure. (Hand washing, preparation of material, surgical field, nursing scrubs and preparation of the catheter). Measurement the correct measurement of the catheter to be inserted in the newborn according to the insertion site's area. (Insertion in inferior limbs' veins and the insertion of the catheter in superior limbs' veins). Preparation of the catheter –the proper preparation of the catheter in relation to its withdrawal, lubrication and movement of the probe or guide wire inside the catheter. Skin asepsis recommended before inserting the central catheter in newborns. Manner of insertion –slow or fast [22].

Said S, et al. at the Neonatal Intensive Care Units of Obstetric & Gynecological Hospital, revealed that, nearly half of the studied nurses had poor knowledge regarding central venous catheters, and more than half of them had incompetent practice regarding central venous catheters. Concluded that, the nurses had poor knowledge, incompetent practice regarding central catheters, and had positive attitude regarding central venous catheter care [23].

Study performed by Abraham LM, et al. included total of 60 staff nurses working in child care areas, from selected hospital in North India. Found that the knowledge on care of peripheral intravenous line in children was excellent, good, and average and below average for 5%, 65%, 25%, 5% respectively among nurses working in child care areas. All the staff nurses had inadequate practices regarding care of peripheral intravenous line. No significant association was observed for knowledge and practice with socio-demographic variables like age, professional qualification, no. of years of

experience and place of training, but there was a statistically significant association for knowledge and practice with place of work and in-service education attendance. There was a weak positive correlation between knowledge and practice of staff nurses related to care of peripheral intravenous line in children.

Chopra V, et al. to assess vascular access nursing experience, practice, knowledge, and beliefs related to PICC insertion and care in 47 Michigan hospitals. Found that more than half of respondents (58%) reported placing PICCs for  $\geq 5$  years, and 23% had obtained dedicated vascular access certification. The most common reported indications for PICC insertion included intravenous antibiotics, difficult venous access, and chemotherapy. Many respondents (46%) reported placing a PICC in a patient receiving dialysis; however, 91% of these respondents reported receiving approval from nephrology prior to insertion. Almost all respondents (91%) used ultrasound to find a suitable vein for PICC insertion, and 76% used electrocardiography guidance to place PICCs. PICC occlusion was reported as the most frequently encountered complication, followed by device migration and deep vein thrombosis. Although 94% of respondents noted that their hospitals tracked the number of PICCs placed, only 40% reported tracking duration of PICC use. Relatedly, 30% of nurses reported that their hospitals had a written policy to evaluate PICC necessity or appropriateness.

Souza RR, et al. to analyze the knowledge of nurses in the Neonatal Intensive Care Unit on the entry, handling, maintenance and withdrawal of the peripherally inserted central catheter. Involving nine nurses from the Neonatal intensive care unit of the Antonio Pedro University Hospital, Fluminense Federal University, revealed that knowledge of nurses regarding, insertion, maintenance and removal of the catheter, Concluded that the use of the peripherally inserted central catheter (PICC) is important in neonatology for its benefits to the infant. So, nurses need to deepen their knowledge so that the care process in the NICU is guided by ethics and based on nursing protocols aiming to base and legitimize such assistance.

Study by Lourenço SA, et al. to determine and evaluated the theoretical and practical knowledge of nurses concerning aspects of PICC line insertion in the case of newborns included forty nurses who graduated on average ten years before and had approximately seven years of professional experience in an ICU investigated. Of these, 37.5% delivered direct care to patients and the remaining had more than one function in their sphere of work. 59.3% worked in pediatrics and neonatology. All of them were qualified to insert a PICC line, through courses provided by three different organizations, with an average workload of 24.9 hours: 13.7 hours of theory and 11.2 of practice. The nurses had an average of three years

of experience in PICC line insertion in newborns.

Also Kleidon TM, et al. to evaluate nurses performance regarding neonates stated that pre-implementation audit (n = 102) and survey (n = 117) data described high rates of PIVC failure (n = 50; 49%), difficulty obtaining equipment (n = 64; 55%) and pressure to insert (n = 50; 43%). Parent interviews (n = 15) identified lack of communication, fear, appreciation of skilled technicians and technology and care giver roles as key to improving the experience. After implementation first-attempt insertion success (45 vs. 62%; risk ratio 1.37, 95% confidence interval 1.05-1.78), first-attempt escalation to senior clinicians (junior doctor 72 vs. 41%.

## Methodology

### Pilot Study for the Questionnaire

To investigate the measure properties of the items which evaluate Nurses Performance, when applied the questionnaire at the recent research population, the researcher applied it on a pilot sample, consisted of (32) subjects, selected randomly from recent research population. After scoring responses the researcher did the following:

### Internal Consistency

The researcher applied Person correlation equation to

	No of Items	Reliability Coefficients	
		Alpha	Spearman-Brown
Performance total scores	9	0.67	0.68

**Table 2:** Shows results of Cronbach's Alpha and Spearman-Brown Reliability Coefficients Performance total scores (n = 32).

**Study design:** A descriptive cross sectional study.

**Study area:** The study was conducted in Khartoum state hospital neonatal intensive care units.

**Study duration:** The study was carried out during the period from 2020 up to 2021.

**Study population:** The study population included all the staff of nurses whom working in neonatal NICU.

**Sample size:** Total coverage of all nurses (105 nurses).

### Data Collections Tools

The check list included two parts, first part for the participants' demographic data as age, gender and the second part for nurses' performance evaluation. Observational

get correlation coefficients between scores of each item to the total score of Performance (Table 1). The following table shows the results of these computations:

Items	Corrected Item-Total Correlation
Examination Gloves	0.479
Use correct Hand	0.472
Wear Gloves	0.149
Gloves Single Use	0.305
Septic by use alcohol	0.209
Allow Drying	0.34
Canola access	0.446
Successful Insertion from	0.52
Date of insertion recorded	0.604

**Table 1:** Shows Person corrected Item-Total Person correlation coefficients for questionnaire items (n = 32).

### Reliability Coefficients

The researcher computed both Cronbach's Alpha and Spearman-Brown Coefficients for Performance total scores. The following table shows the results of these computations (Table 2):

check list.

### Inclusion Criteria

All staff of nurses whom working in intensive care unit and agree to participate in the study.

### Data Analysis

Data was entered using the Statistical Package for Social Sciences (SPSS) version 24 using. Descriptive statistics in term of frequency tables with percentages, graphs and P value set (0.05 or less) is considered significant.

### Data Presentation

Data was represented after analysis in form of tables, cross tabulation (bi variable tables).

### Ethical Consideration

Approval from The Ministry of health research department, the hospital directors and from the participant.

Research purpose and objectives were explained to participants in clear simple words so; Participant has right

to voluntary informed consent, to withdraw at any time without any deprivation. (Privacy and confidentiality by using coded questionnaire. Also the Participants, to benefit from the researcher knowledge and skills and has a right not to harm (protect: during covid 19 Warring mask and spacing) (Table 3).

### Study Sample Descriptions

Descriptions Variable	Levels	Frequency	%
Education	Bachelor	26	24.8
	Master	71	67.6
	Higher	8	7.6
	Total	105	100
Age Levels	21 - 30	57	54.3
	31 - 40	40	38.1
	41 - 50	7	6.7
	Above 50	1	1
	Total	105	100
Attending Training in Neonatology	No	60	57.1
	Yes	40	38.1
	Missing	5	4.8
	Total	105	100
Marital status	Married	42	40
	Single	63	60
	Total	105	100
Experience Levels	LT 6	58	55.2
	10-Jun	24	22.9
	15-Nov	14	13.3
	16 - 20	4	3.8
	Above 20	5	4.8
	Total	105	100

**Table 3:** Shows study sample descriptions according to Gender and Other Demographic variables.

Results show (Table 3) that more than half (54.3%) of nurses between 21-30 years old Majority (60%) of them were single, have (67.6%) master degree, (55.2%) of them their experience less than 6 years (55.2%) of them attended training courses regarding neonatology.

### Study Results

#### Performance Level

To determine level of Nurses Performance, at the recent research population (Table 4), the researcher applied it one sample (t) test, and the flowing table shows the results of these computations:

Subscales of Performance	Mean	SD	Test Value	T value	P. (Sig)	Statistical Inference
Hand Hygiene	1.8	0.49	1.33	9.862	0.001	High
Personal Protective	1.93	0.25	1.33	24.666	0.001	High
Skin Preparation	1.85	0.41	1.33	12.907	0.001	High
Cannula Access	2.75	1.39	2.5	1.858	0.033	Above Med
Date of insertion record	0.37	0.49	0.5	-2.714	0.004	Blow Med
Total core	8.7	1.98	8	3.647	0.001	High

**Table 4:** Shows results of One Sample T Test to determine Nurses Performance, at the recent research population (n = 105).

Most of the nurses their performance was high regarding the preparation for cannulation and above med for insertion

of cannula and most of them did not recorded data of cannula insertion (Table 5).

Age	Frequency	Percent
More Than Third	39	37.1
Third Time	14	13.3
Second time	33	31.4
First time	19	18.1
Total	105	100

**Table 5:** Distribution of nurses according to Successful Insertion of cannula (n=105).

(37.1%) of nurses succeed to insert cannula after more than 3 attempts, 31.4 insert it from the second time, 18.1% from the first time and 13.3% from third time

research population, the researcher computed Spearman correlation coefficients, and the flowing table shows the results of these computations:

### The Correlations

**Between performance & education level:** To determine the significance of the relationship between Nurses Performance and their Educational level, at the recent

Table 6 shows results of Spearman correlation coefficients to explain the significance of relationship between Nurses Performance and their Educational level at the recent research population (n = 105)  
Subscales of Performance

Subscales of Performance	Correlation coefficients	P. (Sig)	Statistical Inference
Hand Hygiene	0.196	0.023	There is a positive correlation
Personal Protective	-0.097	0.164	There is no correlation
Skin Preparation	-0.081	0.206	There is no correlation
Cannula Access	0.215	0.014	There is a positive correlation
Date of insertion record	-0.005	0.479	There is no correlation
Total core	0.2	0.02	There is a positive correlation

**Table 6:** shows results that there significance of relationship between Nurses Performance regarding cannulation and their Educational level.

**Between performance & experience level:** To determine the significance of the relationship between Nurses Performance and their Experience level, at the recent research population, the researcher computed Spearman correlation coefficients, and the flowing table shows the results of these computations:

Table 7 shows results of Spearman correlation coefficients to explain the significance of relationship between Nurses Performance and their Experience level at the recent research population (n = 105).



Subscales of Performance	Correlation coefficients	P. (Sig)	Statistical Inference
Hand Hygiene	0.043	0.33	There is no correlation
Personal Protective	0.115	0.121	There is no correlation
Skin Preparation	0.033	0.371	There is no correlation
Canola Access	0.059	0.275	There is no correlation
Date of insertion record	-0.102	0.151	There is no correlation
Total core	0.029	0.384	There is no correlation

**Table 7:** The results show that there is no significance of relationship between Nurses Performance and their Experience level.

**Between performance & age level:** To determine the significance of the relationship between Nurses Performance and their Age level, at the recent research population, the researcher computed Spearman correlation coefficients, and the flowing table shows the results of these computations:

Table 8 shows results of Spearman correlation coefficients to explain the significance of relationship between Nurses Performance and their Age level at the recent research population (n = 105).

Subscales of Performance	Correlation coefficients	P. (Sig)	Statistical Inference
Hand Hygiene	0.146	0.068	There is no correlation
Personal Protective	0.032	0.373	There is no correlation
Skin Preparation	0.022	0.412	There is no correlation
Canola Access	-0.061	0.269	There is no correlation
Date of insertion record	-0.084	0.197	There is no correlation
Total core	-0.031	0.375	There is no correlation

**Table 8:** Shows results there is no significance of relationship between Nurses Performance and their Age level.

### The Differences

#### According to Marital status

To determine the significance of the differences in Nurses Performance according to their marital status, at the recent research population, the researcher applied Independent Samples (T) Test, and the flowing table shows the results of

these computations:

Table 9 shows results of two independent Samples T Test to explain the significance of differences in Nurses Performance according to their marital status, at the recent research population.

Subscales of Performance	Marital status	Mean	SD	T value	df	P. (Sig)	Statistical Inference
Hand Hygiene	Married	1.79	0.52	-0.244	103	0.808	There isn't sig difference
	Single	1.81	0.47				
Personal Protective	Married	1.95	0.216	0.634	103	0.527	There isn't sig difference
	Single	1.92	0.272				
Skin Preparation	Married	1.88	0.395	0.677	103	0.5	There isn't sig difference
	Single	1.83	0.423				
Canola Access	Married	2.6	1.432	-0.944	103	0.347	There isn't sig difference
	Single	2.86	1.366				
Date of insertion record	Married	0.26	0.445	-1.957	95	0.053	There isn't sig difference
	Single	0.44	0.501				
Total Scores	Married	8.48	2.063	-0.965	103	0.337	There isn't sig difference
	Single	8.86	1.925				

**Table 9:** Shows results there is no significance of relationship between Nurses Performance and their marital status.

## According to Attending Training in Neonatology

To determine the significance of the differences in Nurses Performance according to attending Training in Neonatology, at the recent research population, the researcher applied Independent Samples (T) Test, and the flowing table shows

the results of these computations:

Table 10 shows results of two independent Samples T Test to explain the significance of differences in Nurses Performance according to attending Training in Neonatology, at the recent research population.

Subscales of Performance	Attending Training	Mean	SD	T value	df	P. (Sig)	Statistical Inference
Hand Hygiene	No	1.8	0.514	0.245	98	0.807	There isn't sig difference
	Yes	1.78	0.48				
Personal Protective	No	1.93	0.252	0.158	98	0.874	There isn't sig difference
	Yes	1.93	0.267				
Skin Preparation	No	1.82	0.469	-0.679	98	0.499	There isn't sig difference
	Yes	1.88	0.335				
Canola Access	No	2.58	1.33	-1.12	98	0.266	There isn't sig difference
	Yes	2.9	1.46				
Date of insertion record	No	0.32	0.469	-1.332	80	0.187	There isn't sig difference
	Yes	0.45	0.504				
Total Scores	No	8.45	1.79	-1.176	98	0.242	There isn't sig difference
	Yes	8.93	2.24				

**Table 10:** Shows results that there is no significance of differences in Nurses Performance according to attending Training in Neonatology.

## Discussion

The procedures of inserting a peripheral intravenous cannula and blood sampling are carried out in most health care settings, but they can be among the most frustrating tasks encountered by nurses. Moreover, it considers one of the recognized challenges of pediatrics due to the veins of children are frequently small, embedded in subcutaneous fat tissue, or simply exhausted from previous blood sampling attempts (Andrews, 2011). Unsuccessful attempts may lead to frustration, anxiety, and loss of self-confidence and damage the trust relationship between the child and the nurse. Thus, this study aimed to assess nurses' performance regarding to intravenous cannulation in pediatric health care setting.

In the current study, the characteristics of the studied nurses revealed that, More than half (54.3%) of nurses were between 21-30 years of age (Table 1). This finding was in an agreement with Essani and Ali, in their study about Knowledge And Practice Gaps Among Pediatric Nurses At A Tertiary Care Hospital Karachi Pakistan who revealed that the majority of nurses' age was between 20-30 years with mean 25.9 years. These findings might be due to that, most of

the nurses aged between 18-30 years..Concerning previous experiences of the studied nurses (Table 1), findings of the study showed that more than half of the nurses had experience for less than 6 years. This finding was not in an agreement with that of Perry, et al. who found that 43% of the studied nurses had 5<10 years of experience.

It was clear from Table 2 that almost two thirds of the studied nurses had a master of nursing sciences, while about a third of them had obtained a bachelor of nursing sciences. This finding was contradicting with those of Arbaee and Mohd Ghazali, who found in a similar study that 79% of nurses had a diploma of nursing. On the other side, Sriuapyo, et al. who studied Effectiveness of Peripheral Vascular Catheter Care Bundle in the Pediatric Nursing Service, Chiang Mai University Hospital, Thailand found that the majority of the studied nurses had a bachelor of nursing. In relation to the nurses' attendance of training courses, Table 3 showed that more than half of the studied nurses had previously attended training courses. This finding was similar to those of the study conducted by Sriuapyo, et al. who found that more than half of the studied nurses had previous training or conference attendance regarding the PVC care bundle.



Concerning nurses' performance regarding hand hygiene, the mean of nurses' performance about hand hygiene was 74.4%, while great majority of them correctly use personal protective equipment (gloves). Great majority of nurses (59%) use 70% isopropyl alcohol as skin aseptic. Regarding cannula access, more than half of nurses (55.2%) use 2% chlorhexidine gluconate in 70% isopropyl alcohol and allow drying prior to accessing the cannula for administering fluids or injection. Only (37.1%) of nurses succeed to insert cannula from the first attempt. And only 37.1% recorded date of insertion of cannula.

Regarding to total nurses' level of practice about peripheral intravenous cannulation the current study results showed that the great majority of the studied nurses had unsatisfactory practice. This finding was to some extent similar to that of Chang, et al. Johor Bahru, Chang, et al. stated that, measures were generally higher during preparation but low during the actual performance of venepuncture and intravenous cannulation in the pediatric unit in hospital. One possible explanation of these results that there was a knowledge-practice gap and lack of integration of theoretical knowledge into practice although nurses has good experience and most them receive training courses but there are no correlation between the nurses performance regarding cannulation and their experience, age or marital status, Just there is positive correlation between their performance and their educational level that is main the training courses not including practical insertion of cannulation , also these gaps were related to clinical knowledge that nurses perform in pediatric settings that are very essential for child care.

## Conclusion

The studies concluded that nurses' performance regarding cannulation is high but, there is lacking practice toward peripheral intravenous cannulation in some pediatric health settings and there are no correlation bet the performance of cannulation and their experience, age or marital status, Just there is positive correlation between their performance and their educational level.

## Recommendation:

The study recommended that

- Continuing training, educational programs and workshops concern the care of children with peripheral intravenous cannulation to nursing staff working in pediatric health care setting.
- More training practice for neonatal cannulation.
- More studies on larger population to allow greater generalization of study.
- Interventional study needed to treat the lacking of the practice, for competence and quality of the work.

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