

# Adherence of Pediatric Critical Care Nurses to Blood Sampling Guidelines in Intensive Care Units of Children's University Hospitals at Alexandria

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## Abstract

**Background:** Blood sampling is a frequently used clinical diagnostic procedure in pediatric critical care units. However, it also carries several risks due to poor blood sampling practices. Adherence to recent blood sampling guidelines by pediatric critical care nurses is crucial in preserving the safety of both nurses and the pediatric population and achieving positive outcomes. **Aim:** This study aimed to identify the adherence of pediatric critical care nurses to blood sampling guidelines in intensive care units of children's university hospitals at Alexandria. **Settings:** The study was conducted in Neonatal Intensive Care Unit at Smouha University Children's Hospital and Surgical Intensive Care Unit at El-Shatby University Hospital for Children. **Subjects:** All available pediatric critical nurses (56 nurses) from the previously mentioned settings who were responsible for performing blood sampling procedures for neonates, infants, and children. **Tool:** One tool was used to collect the necessary data: Adherence of Pediatric Critical Care Nurses to Blood Sampling Guidelines among Critically Ill Children Observational Checklists. **Results:** More than three-quarters of pediatric critical care nurses (78.9%) had a good adherence to venipuncture guidelines during the procedure; slightly less than three-quarters of pediatric critical care nurses (73.7%) obtained a good adherence level regarding arterial puncture guidelines during the procedure; less than two-thirds of pediatric critical care nurses (62.9%) had a good adherence level regarding capillary blood sampling guidelines during the procedure. **Conclusion:** It was concluded from this study that the majority of pediatric critical care nurses had overall "good" adherence to blood sampling guidelines. **Recommendations:** Creating continuous training programs for nurses on applied recent blood sampling guidelines is recommended to enhance their knowledge and practices of care provided for neonates, infants, and children undergoing venous, arterial, and capillary blood sampling.

**Keywords:** Adherence, Blood Sampling, Guidelines, Intensive Care Units, Pediatric Critical Care Nurses  
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## Introduction

Critically ill neonates, infants, and children are those whose age ranges from birth to 18 years old and have a crucial status that demands constant monitoring and care because they are more susceptible to illness or damage than others.

Accordingly, these pediatric populations are admitted to intensive care units (ICUs) that deliver crucial care services with precise attention and skills provided by medical and nursing specialist teams (Sabaq et al., 2019). Also, these

children are subjected to a range of invasive procedures that are performed every day in ICUs, such as endotracheal tube suctioning, nasogastric tube insertion, and blood sampling procedures (Kassab et al., 2019).

Blood sampling is the most frequently invasive procedure carried out in intensive care units (Bazzano et al., 2021). It refers to the act of drawing a specimen of the circulating blood through a puncture from either a vein, an artery, or capillaries for hematological, biochemical, or bacteriological analysis (Davies et al., 2020; Hjelmgren et al., 2023). Blood samples carry several dangers that, if done improperly, could endanger the health of neonates, infants, and children (Simundic et al., 2018). These risks result in longer hospital stays, higher medical service expenditures (Hjelmgren et al., 2023), and worse pediatric population outcomes. Additionally, it puts medical professionals at risk for needle stick injuries and the spread of blood-borne illnesses (WHO, 2021).

Accordingly, it is critical for pediatric critical care nurses to follow approved recommended guidelines to avoid laboratory errors and injuries to the pediatric population. Therefore, recommendations on the best practices of blood sampling were convened and reaffirmed by WHO in 2010 and revised by the Guidelines Review Committee of WHO in 2021. Adherence to such guidelines lowers human error brought on by a lack of uniformity and enhances the quality of blood specimens (Hjelmgren et al., 2023; Simundic et al., 2015)

Pediatric critical care nurses play a crucial role in diminishing the potential negative impact of blood sampling on critically ill neonates, infants, and children (Alam et al., 2020;

Kotasthane et al., 2019). As a result, constant assessment of a nurse's performance during the collection of a blood specimen gives them the new in care and efficient performance to adhere to the highly skilled level of care (Ibraheem et al., 2023).

**Aim of the study:** This study aimed to assess the adherence of pediatric critical care nurses to blood sampling guidelines in intensive care units of children's university hospitals at Alexandria.

**Research question:** What is the level of pediatric critical care nurses' adherence to blood sampling guidelines in intensive care units of children's university hospitals at Alexandria?

### **Materials and Methods**

**Study design:** A descriptive research design was used to accomplish this study.

**Setting:** This study was conducted in Neonatal Intensive Care Unit (NICU) at Smouha University Children's Hospital and Surgical Intensive Care Unit (SICU) at El-Shatby University Hospital for Children.

**Subjects and Sampling:** Non-probability convenience sampling technique was used. All available pediatric critical nurses (56 nurses) plus seven pediatric critical care nurses in pilot study from the previously mentioned settings who are responsible for performing blood sampling procedures for neonates, infants, and children comprised the study subjects

### **Tool:**

One tool was used to collect the data: -

***Adherence of Pediatric Critical Care Nurses to Blood Sampling Guidelines among Critically Ill Children Observational Checklist:*** -

This tool was developed by the researcher after reviewing recent and relevant literature to assess adherence of pediatric critical care nurses to

blood sampling guidelines for children in intensive care units. (WHO, 2021; CDC, 2020; Simundic et al., 2018) It consisted of three parts:

Part 1: Nursing Care before Blood Sampling Procedure included four main domains which are critical care nurse preparation (five sub-items), neonate/infant/child preparation (five sub-items), preparation of equipment/supplies (three sub-items), and preparation of environment (two sub-items). Thus, it contains fifteen sub-items.

Part 2: Nursing Care during Blood Sampling Procedure included techniques of each type of blood sampling procedure; venipuncture, arterial puncture, and capillary sampling (Heel stick, fingerstick). Concerning venipuncture technique involved 24 steps, while the arterial puncture technique involved 23 steps, and finally in heel stick or finger prick technique for capillary sampling included 17 steps.

Part 3: Nursing Care after Blood Sampling Procedure included ten steps which are elevation of the puncture site and its assessment, labeling and transportation of blood specimens, applying adhesive bandage on the puncture site, discarding supplies, removing personal protective equipment, performing hand hygiene, monitoring perfusion distal to puncture site, and documentation.

**Scoring system:** Every step of each technique in blood sampling procedure was scored as follows: correctly done (1), and incorrectly done/ not done (zero), or not applicable step/NA according to the child's age.

The total score of pediatric critical care nurses' adherence to blood sampling guidelines was transformed into percentage and classified in a qualitative manner as follows: The level was categorized as follows –

- Good adherence level →  $\geq 70\%$ .
- Satisfactory adherence level → from 70 to  $\leq 50\%$ .
- Poor adherence level →  $< 50\%$

Socio-demographic characteristics of pediatric critical care nurses were attached to the study tool and included age, gender, level of education, years of experience, and attendance of any previous training courses related to blood sampling procedure.

### Method

- Approval from Ethical Research Committee, Faculty of Nursing, Alexandria University was obtained before carrying out the study on 17 July 2023.( serial number: AU-20-4-71 /IRB00013620 (9/19/2025)).
- An official letter was sent from Faculty of Nursing to the administrative authorities of the previously mentioned settings to facilitate research implementation after explaining the aim of the study.
- The study tool was developed by the researcher and tested for its content validity by five experts in the field of Pediatric Nursing, and necessary modifications were made, the validity of the tool was 95.3%. based on their comments.
- Reliability of the tool was ascertained using an appropriate statistical test where  $r = 0.956$ .
- A pilot study was carried out on seven pediatric critical care nurses to test the clarity and feasibility of the tool. Accordingly, necessary modifications were made. Those nurses were excluded from the study subjects.
- Every pediatric critical care nurse was observed individually in the morning shift by the researcher three times while performing blood sampling using the study tool (Total observations = 168).
- Assessment of pediatric critical nurses three times according to the required available blood sampling procedure (venipuncture or arterial puncture or capillary blood sample either heel stick or finger prick) using the study tool .

Average observations were calculated (n = 57 venipuncture observations, 76 arterial puncture observations, 35 capillary blood sample observations).

- Each observation took an average of eight minutes in a venipuncture blood collection, five minutes in arterial blood collection, and only one minute in a capillary blood sample either heel stick or finger prick for each observation.
- Data concerning characteristics of nurses was obtained from the head nurse of each intensive care unit.
- Data was collected over a period of seven months from the beginning of October 2023 to the end of April 2024.
- **Ethical Considerations:** Witness informed consent was obtained from the head nurses of the ICUs of previously mentioned settings after explaining the aim of the study, confidentiality of data was ascertained, and anonymity of subjects was maintained.
- After completing data collection, the necessary statistical analysis was done to assess adherence of pediatric critical care nurses to blood sampling guidelines in intensive care units.
- **Statistical Analysis:** Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and Median. Significance of the obtained results was judged at the 5% level.

## Results

**Table (I)** presents the sociodemographic characteristics of the studied nurses. It was found that more than half of pediatric critical care

nurses (55.4%) were aged less than 30 years, with a mean age of  $31.29 \pm 7.54$  years. It was found that the majority of the pediatric critical care nurses (80.4%) were females. Additionally, it was reported that more than half of pediatric critical care nurses (57.1%) had a bachelor's degree in nursing. Regarding years of experience, it was recorded that 42.9% of pediatric critical care nurses had less than five years of experience in the intensive care units, with a mean year of experience of  $7.95 \pm 6.70$  years. It was also observed that 60.7% of studied nurses attended training courses about blood sampling guidelines.

**Figure (I)** sheds light on the adherence level of pediatric critical care nurses to blood sampling guidelines. It was found that the majority of pediatric critical care nurses (82.1%) had good adherence level regarding blood sampling guidelines before the procedure. Additionally, the majority of pediatric critical care nurses (83.9%) had good adherence regarding blood sampling guidelines during the procedure, and the majority of pediatric critical care nurses (82.1%) had a good adherence level regarding blood sampling guidelines after the procedure.

**Figure (2):** illustrates the adherence levels of the studied nurses regarding blood sampling guidelines during the procedure. It was noted that more than half of three-quarters of pediatric critical care nurses (78.9 %) had good adherence concerning blood sampling guidelines for venipuncture during the procedure. Moreover, 73.7% of pediatric critical care nurses obtained good adherence to blood sampling guidelines regarding arterial puncture during the procedure. Additionally, it was revealed that 62.9% of pediatric critical care nurses had good adherence to capillary blood sampling guidelines during the procedure.

**Figure (3):** shows the overall adherence level of pediatric critical care nurses to blood sampling

guidelines. It was found that the majority of pediatric critical care nurses (89.3%) had good adherence to blood sampling guidelines. And none of them had poor adherence.

**Table (II)** represents the adherence of pediatric critical care nurses regarding blood sampling guidelines before the procedure. It was illustrated that all the pediatric critical care nurses (100%) verified the physician's orders. while 59.5% of pediatric critical care nurses didn't assess puncture sites for any contraindications.

**Table (III)** illustrates the adherence of pediatric critical care nurses regarding venipuncture guidelines during the procedure. It was shown that 100% of pediatric critical care identified an appropriate venipuncture site and ensured the puncture site was warm before blood collection. On the other hand, 73.7% of studied nurses didn't withdraw the blood volume needed for the ordered laboratory tests by pulling gently on the syringe plunger to fill the syringe with blood.

**Table (iv)** clarifies the adherence of pediatric critical care nurses regarding arterial puncture guidelines during the procedure. It was clear that more than three-quarters of pediatric critical care nurses (78.9%) didn't locate the radial artery by performing a modified Allen's test for collateral circulation, or if the initial test failed to locate the radial artery, they didn't repeat the test on the other hand.

**Table (v)** clarifies the adherence of pediatric critical care nurses regarding capillary blood sampling guidelines during the procedure. It was revealed from the table that all the pediatric critical care nurses (100%) held the lancet device firmly and at 90° against the skin, and punctured the skin with one quick, continuous, and deliberated stroke with appropriate depth.

**Table (vi)** explains the adherence of pediatric critical care nurses regarding blood

sampling guidelines after the procedure. It was noticed that all the pediatric critical care nurses (100%) labeled the specimen per the organization's practice, and the majority of pediatric critical care nurses (90.5%) checked the infant's/child's puncture site for bleeding

### Discussion

Blood sampling is standard practice for diagnosing neonates, infants, and children's illnesses, monitoring their progress, and evaluating the efficacy of treatments in intensive care units (Chang et al., 2020; Hjelmgren et al., 2023). Multiple distinct steps are involved, the whole of which can be liable to errors that create numerous problems and threaten safety for both pediatric populations and healthcare providers, leading to necessitating repeated blood draws and delaying medical decisions (Hjelmgren et al., 2023).

In such context, the current study findings revealed that the majority of pediatric critical care nurses had a good adherence level regarding the blood sampling guidelines before the procedure (Figure 1). Whereas all pediatric critical care nurses verified the physician's orders (Table II). These findings may be due to increased nurses' awareness about the significance of determining the order of blood analysis needed to confirm the physician's order and to check if any instructions are required before initiating the specimen withdrawal. These findings were relatively inconsistent with Ahmed and Ali (2016) findings, which reported that a minority of the nurses verified the written order and prepared the environment.

The finding of the current study revealed that more than half of the pediatric critical care nurses assessed vein puncture sites before puncturing for any contraindications (Table II). This result may be justified by the enhanced nurse's awareness of

the significance of preserving the safety of the pediatric population and avoiding any hazards for limbs due to puncturing contraindicated sites (defects in peripheral circulation). This finding of the current study was inconsistent with Atalla and Henedy (2018) results, which revealed that when selecting a vein, about half of the study population was unaware of certain areas to avoid before carrying out the teaching program.

Concerning venous blood sampling, the current study findings showed that more than three-quarters of pediatric critical care nurses applied the venipuncture sampling guidelines during the procedure with a good level of adherence (Figure 2). Whereas all pediatric critical care identified an appropriate venipuncture site and ensured the puncture site was warm before blood collection (Table III). These findings can be explained by the fact that more than half of pediatric critical care nurses had at least five years of experience in the ICUs (Table I). Another justification: continuous monitoring and education rounds were performed by the infection control team, giving them access to new information and competent performance. These findings agreed with the findings of Ibraheem et al. (2023) findings, which reported the majority of pediatric critical care nurses had proficient experience withdrawing venous blood samples. On the other hand, these findings were contrary to Nilsson (2016) findings, which showed that healthcare staff members were not adhering to practice guidelines for venous blood specimen withdrawal.

Unfortunately, the current study findings clarified that more than two-thirds of nurses didn't place a sheathed needle (23 venipuncture needle or butterfly needle with extension tubing) on the syringe and withdrew the blood volume needed for the ordered laboratory tests by pulling

gently on the syringe plunger to fill the syringe with blood (Table III). In fact, these findings may be due to the lack of medical supplies and equipment in the units. So, these units applied another technique, such as breaking or cutting the hub of sterile hypodermic needles (23 or 24 gauge) and inserting the needle in the vein directly without a syringe attached to the needle to collect a blood sample.

Although arterial puncture is usually more technically difficult and more painful than venous puncture, the current study findings found that nearly three-quarters of pediatric critical care nurses applied the arterial puncture sampling guidelines during the procedure with a good level of adherence (Figure 2). These findings may be due to the medical order in ICUs stating that an arterial blood gas (ABG) sample must be taken from every pediatric population connected to a mechanical ventilator each morning shift to track the progress of the pediatric illness. This repetitive, routine procedure may be the reason, as it helps nurses remember procedure steps and become more expert.

These findings were inconsistent with Abd Elaziz et al. (2021) findings, which showed that just a small percentage of pediatric critical care nurses had a proficient level of practice before receiving video-assisted teaching intervention. Moreover, the current study findings were inconsistent with Mohamed and Said (2020) findings, which indicated that before the implementation of the computer-based learning module, the majority of the nurses under study exhibited incompetent practices regarding arterial blood gas (ABG) sampling.

The Allens test is necessary to check a hand's collateral circulation via palmer arches (Kapadia, 2017). The current study revealed that more than

three-quarters of nurses didn't locate the radial artery by performing a modified Allen's test for collateral circulation, and if the initial test failed to locate the radial artery, they didn't repeat the test on the other hand (**Table iv**). These findings may be due to pediatric critical did not know either the proper technique for performing Allen's test or its significance in preventing complications in pediatric populations. These findings were consistent with Botros et al. (2019) findings, which showed that Allen's test was not performed by any nurse.

Regarding capillary blood collection, the current study findings found that less than two-thirds of pediatric critical care nurses applied capillary blood collection guidelines during the procedure with a good level of adherence (Figure 2). Whereas all pediatric critical care nurses held the lancet device firmly and at 90° against the skin, and they punctured the skin with one quick, continuous, and deliberate stroke with appropriate depth (**Table v**). These findings may be due to its minimally invasive procedure containing simple and easy steps that were repeated daily in ICU settings requiring small blood volume. The current study findings were consistent with Faugère et al. (2022) findings. On the other hand, the current study findings were inconsistent with Shaban Ibrahim et al. (2024) findings.

The current study findings revealed that the majority of pediatric critical care nurses had good adherence level regarding the blood sampling guidelines after the procedure (Figure 1). Whereas all pediatric critical care nurses labeled the specimen per the organization's practice, and the majority of pediatric critical care nurses checked the infant's/child's puncture site for bleeding (**Table vi**). These findings may be due to enhanced nurses' knowledge and full understanding of the significance of obtaining

high-quality blood specimens with the least pre-analytical errors to prevent sample rejection.

These findings were consistent with Sharma and Flinsi (2017) findings, which showed that the majority of studied nurses had a satisfactory level of adherence to laboratory specimen safety practices. On the other hand, these findings were inconsistent with Zehra et al. (2016) findings, which showed that most of the participants were not following standard guidelines.

Concerning the overall adherence of pediatric critical care nurses to blood sampling guidelines among critically ill children, the findings of the present study revealed that the majority of pediatric critical care nurses had good adherence level (Figure 3). These findings may be due to the existence of ongoing camera registration-based monitoring and observation. This might motivate nurses to improve the care they deliver. They might have adhered to blood sample guidelines more strictly if they had known they were being observed, or had periodic reminders and training workshops, which enhanced compliance with blood sample criteria. Furthermore, an incentive from the nursing supervisor and the medical director to provide children with high-quality treatment is another factor.

These findings agreed with Dey et al. (2023) findings and with Zaki et al. (2022) findings which indicated the majority of nurses had a satisfactory level of practice regarding blood specimen withdrawal. On the other hand, these findings were inconsistent with Zehra et al. (2016) findings Soliman et al. (2019) findings which showed that the majority of participants did not follow accepted practices of blood samples.

**Conclusion**

Based on the findings of the current study, it can be concluded that the majority of pediatric critical care nurses had overall good adherence to blood sampling guidelines, and none of them obtained poor adherence.

**Recommendations**

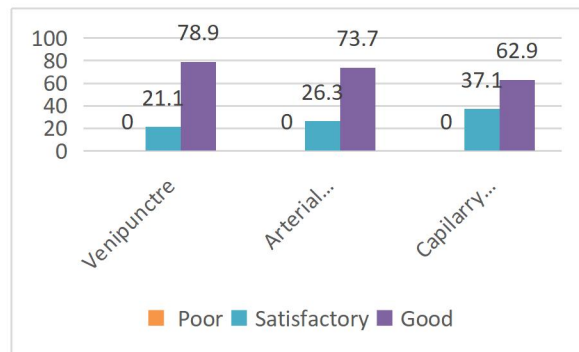
The researcher recommended that:

- Creating continuous training programs for nurses on recent and updated blood sampling guidelines is recommended to enhance their knowledge and practices.
- Developing videos explaining the actions involved in every blood sampling procedure with clarity, which nurses can access anytime they're needed.

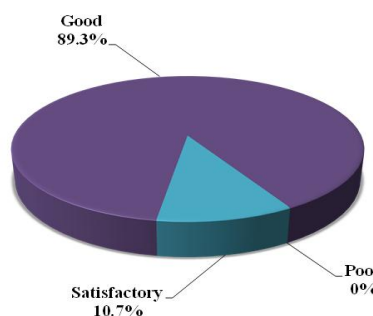
**Limitations of the study:**

It is significant to highlight that this study was implemented with a constrained sample size of only 56 pediatric critical care nurses, which may restrict the result's generalizability to different healthcare facilities.

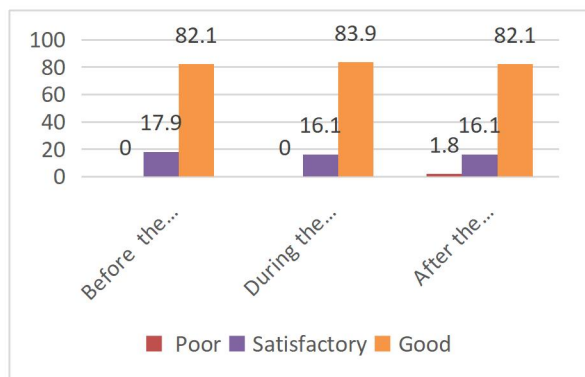
**Figure (1): The Adherence Levels of Studied Nurses Regarding Blood Sampling Guidelines.**



**Figure (2): The Adherence Levels of the Studied Nurses Regarding Blood Sampling Guidelines During the Procedure.**



**Figure (3): The Overall Adherence Levels of the Studied Nurses Regarding Blood Sampling Guidelines**



**Table (I): Socio-Demographic Characteristics of Studies Nurses**

Characteristics of pediatric critical care nurses		No.	%
<b>Age</b>	< 30	31	55.4
	30 – <40	18	32.1
	≥ 40	7	12.5
	Min. – Max. Mean ± SD.	23.0 – 52.0 31.29 ± 7.54	
<b>Gender</b>	Male	11	19.6
	Female	45	80.4



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<b>Level of education</b>	Secondary School of Nursing Diploma	4	7.2
	Technical Institute of Nursing Diploma	20	35.7
	Bachelor's Degree in Nursing	32	57.1
	Postgraduate Studies in Nursing	0	0.0
	Others	0	0.0
<b>Years of experience</b>	< 5 Years	24	42.9
	5 < 10 Years	17	30.3
	10 years and more	15	26.8
	Min. – Max. Mean ± SD.	1.0 – 27.0 7.95 ± 6.70	
<b>Attendance of training courses</b>	Yes	34	60.7
	No	22	39.3

SD: Standard deviation

n=56 (number of nurses)

**Table (II): Adherence Levels of Pediatric Critical Care Nurses to Blood Sampling Guidelines Before the Procedure (n = 56)**

A. Before Blood Sampling Collection:	Done		Not done		NA	
	No.	%	No.	%	No.	%
<b>a. Critical care nurse preparation:</b>						
1. Verify the physician's orders.	168	100.0	0	0.0	0	0.0
2. Perform hand hygiene	142	84.5	26	15.5	0	0.0
3. Introduce herself, be warm and friendly.	13	7.7	22	13.1	133	79.2
4. Wear appropriate personal protective equipment (gown, face protection)	56	33.3	112	66.7	0	0.0
5. Seek assistance from another healthcare nurse.	101	60.1	67	39.9	0	0.0
<b>b. Neonate/ Infant/ Child preparation:</b>						
6. Identify the child	164	97.6	4	2.4	0	0.0
7. Providing clear and comprehensive information about a procedure according to the child's comprehensive level.	24	14.2	10	6.0	134	79.8
8. Assess puncture sites for any contraindications. as (hematoma, IV line, or hemodialysis shunt, renal graft, and fistulas in the extremities)	100	59.5	68	40.5	0	0.0
9. Place a clean paper or towel under the child's arm	111	66.1	57	33.9	0	0.0
10. Provide pain management	154	91.7	14	8.3	0	0.0
<b>c. Prepare equipment/supplies</b>						
11. Clear off a bedside work area	91	54.2	77	45.8	0	0.0
12. Collect and assemble the equipment and supplies for the procedure.	162	96.4	6	3.6	0	0.0
13. Use small a gauge needle to avoid puncture site collapse in venipuncture, and arterial sampling, or use a lancet in capillary sampling.	134	79.8	34	20.2	0	0.0
<b>d. Prepare Environment</b>						
14. Draw curtains to provide privacy for the child or use a designated treatment area.	168	100.0	0	0.0	0	0.0
15. Ensure adequate lighting.	168	100.0	0	0.0	0	0.0
<b>Mean ± SD.</b>			<b>77.86 ± 7.73</b>			

**Table (III): Adherence of Pediatric Critical Care Nurses Regarding Venipuncture Guidelines During the Procedure. (n = 57 observation)**

I. Venipuncture	Done		Not done		NA	
	No.	%	No.	%	No.	%
1. Identify an appropriate venipuncture site:	57	100.0	0	0.0	0	0.0
2. Ensure the puncture site is warm before blood collection.	57	100.0	0	0.0	0	0.0
3. Immobilize the child and position the extremity	57	100.0	0	0.0	0	0.0
4. Extend the child's arm and inspect the antecubital fossa or forearm.	42	73.7	15	26.3	0	0.0
5. Locate a vein of a good size that is visible, straight, and clear	57	100.0	0	0.0	0	0.0
6. Observe and palpate the vein in the selected puncture area.	57	100.0	0	0.0	0	0.0
7. Put the tourniquet on the child's arm about two finger widths above the venipuncture site.	29	50.9	28	49.1	0	0.0
8. Wearing well-fitting, non-sterile gloves	40	70.2	17	29.8	0	0.0
9. Disinfect of puncture site	29	50.9	28	49.1	0	0.0
10. Allow the puncture site to dry completely.	18	31.6	39	68.4	0	0.0
11. Place a sheathed needle (23 venipuncture needle or butterfly needle with extension tubing) on the syringe.	16	28.1	41	71.9	0	0.0
12. Remove the cap and turn the bevel up.	57	100.0	0	0.0	0	0.0
13- Use a thumb to draw the skintight, about two finger widths below the venipuncture site.	39	68.4	18	31.6	0	0.0
14. Hold the needle at a slight angle with the bevel facing up. The angle of entry is 15 to 30 degrees	57	100.0	0	0.0	0	0.0
15. Puncture the skin 3–5 mm distal to the vein.	53	93.0	4	7.0	0	0.0

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16. Enter the vein using a quick, small thrust to penetrate the skin.	57	100.0	0	0.0	0	0.0
17. If the needle enters alongside the vein rather than into it, withdraw the needle slightly without removing it completely, and angle it into the vessel.	57	100.0	0	0.0	0	0.0
18. Verify entry into the vein by watching for a flashback of blood into the needle	57	100.0	0	0.0	0	0.0
19. Release the tourniquet.	28	49.1	29	50.9	0	0.0
20. Withdraw the blood volume needed for the ordered laboratory tests by pulling gently on the syringe plunger to fill the syringe with blood	15	26.3	42	73.7	0	0.0
21. Apply a sterile gauze pad over the puncture site without applying pressure.	56	98.2	1	1.8	0	0.0
22. Withdraw the needle from the vein slowly but carefully.	57	100.0	0	0.0	0	0.0
23. Immediately apply mild pressure over the venipuncture site for at least 2 minutes.	51	89.5	6	10.5	0	0.0
24. Fill laboratory tubes in a correct order	21	36.8	36	63.2	0	0.0

**Table (iv): Adherence of Pediatric Critical Care Nurses Regarding Arterial Puncture Guidelines During the Procedure (n = 76 observation).**

II: Arterial Blood Sampling	Done		Not done		NA	
	No.	%	No.	%	No.	%
1. Select an appropriate site for arterial puncture.	76	100.0	0	0.0	0	0.0
2. Immobilize and position the child	76	100.0	0	0.0	0	0.0
3. Palpate the puncture site	75	98.7	1	1.3	0	0.0
4. Locate the radial artery by performing a modified Allen's test for collateral circulation.	0	0.0	60	78.9	16	21.1
5. If the initial test fails to locate the radial artery, repeat the test on the other hand	0	0.0	60	78.9	16	21.1
Disinfect the site.	50	65.8	26	34.2	0	0.0
7. Allow the puncture site to dry completely.	46	60.5	30	39.5	0	0.0
8. Wear sterile gloves	31	40.8	45	59.2	0	0.0
9. Holding the heparinized syringe and needle like a dart	76	100.0	0	0.0	0	0.0
10. Use the index finger to locate the pulse again	68	89.5	8	10.5	0	0.0
11. Insert the needle gently but firmly in the area where the maximum impulse is felt at a 45-degree angle to the radial or brachial artery while penetrating a femoral artery at 60-90 degree	76	100.0	0	0.0	0	0.0
12. Insert the needle approximately 1 cm distal to (away from) the index finger	71	93.4	5	6.6	0	0.0
13. Advance the needle into the artery until the blood flashback appears	76	100.0	0	0.0	0	0.0
14. Allow the syringe to fill to the appropriate level.	75	98.7	1	1.3	0	0.0
15. Don't pull back the syringe plunger	6	7.9	70	92.1	0	0.0
16. If resistance is felt while advancing the needle deeper, the needle is slowly withdrawn, and advancement is changed slightly to one side and then to the other.	75	98.7	1	1.3	0	0.0
17. If the artery has not been punctured after redirecting the needle several times, withdraw the needle and obtain a new setup if the puncture is to be attempted again.	36	47.4	17	22.4	23	30.3
18. withdraw the needle and syringe, after obtaining a blood sample.	76	100.0	0	0.0	0	0.0
19. Immediately place a sterile, dry piece of gauze or cotton wool over the site	76	100.0	0	0.0	0	0.0
20. Apply firm pressure for sufficient time to stop the bleeding for at least 2-3 minutes.	71	93.4	5	6.6	0	0.0
21. Expel air bubbles	76	100.0	0	0.0	0	0.0
22. Cap the syringe to prevent contact between the arterial blood sample and the air.	76	100.0	0	0.0	0	0.0
23. Roll the specimen between the hands to gently mix it.	7	9.2	69	90.8	0	0.0

**Table (v): Adherence of Pediatric Critical Care Nurses Regarding Capillary Blood Sampling Guidelines During the Procedure (Heel-prick, Finger-pick)). (n = 35 observation.)**

III: Capillary Sampling (Heel-prick, Finger-pick)	Done		Not done		NA	
	No.	%	No.	%	No.	%
1. Identify the correct puncture site based on the age and weight of the children.	34	97.1	1	2.9	0	0.0
2. Ensure the finger or heel is warm before blood collection.	35	100.0	0	0.0	0	0.0
3. Immobilize the infant, ask the assistant nurse to have a firm comfortable hold of the infant/ child during the procedure if required.	35	100.0	0	0.0	0	0.0
4. Put on well-fitting, non-sterile gloves	14	40.0	21	60.0	0	0.0
5. Disinfect the puncture site.	6	17.1	29	82.9	0	0.0
6. Allow the area to dry completely	5	14.3	30	85.7	0	0.0
7. Immobilize the heel/ finger to be punctured.	35	100.0	0	0.0	0	0.0
8. Hold the lancet device firmly and at 90° against the skin.	35	100.0	0	0.0	0	0.0
9. Puncture the skin with one quick, continuous, and deliberate stroke with appropriate depth.	35	100.0	0	0.0	0	0.0
10. Relax tension on the heel/finger	35	100.0	0	0.0	0	0.0
11. Wipe the first drop of blood away as it may be contaminated by fluid or debris (sloughing skin).	6	17.1	29	82.9	0	0.0
12. Avoid squeezing the finger or heel too tightly because this dilutes the specimen with tissue fluid (plasma) and increases the probability of hemolysis.	22	62.9	13	37.1	0	0.0
13. Gentle "pumping" of the extremity above the puncture site may encourage blood flow.	12	34.3	23	65.7	0	0.0
14. Perform another puncture with a new lancet in a different site if blood does not flow freely rather than squeezing the heel or finger.	10	28.6	2	5.7	23	65.7
15. Don't puncture the skin more than once with the same lancet or use a single puncture site more than	34	97.1	1	2.9	0	0.0

once						
16. Immediately place a sterile, dry piece of gauze over the site	35	100.0	0	0.0	0	0.0
17. Apply firm pressure for sufficient time to stop the bleeding for at least 30-1 minutes.	35	100.0	0	0.0	0	0.0

**Table (vi): Adherence of Pediatric Critical Care Nurses Regarding Blood Sampling Guidelines After the Procedure (n = 168) (3 observations)**

After Blood Sample Collection	Done		Not done		NA	
	No.	%	No.	%	No.	%
1. Elevate the puncture site when the blood collection procedure is completed.	118	70.2	50	29.8	0	0.0
2. Label the specimen per the organization's practice. if the test is not immediately required.	168	100.0	0	0.0	0	0.0
3. Place the labeled specimen in a biohazard bag and transport the specimen to the laboratory immediately, per the organization's practice. if the test is not immediately required.	168	100.0	0	0.0	0	0.0
4. Check the infant's/child's puncture site for bleeding	152	90.5	16	9.5	0	0.0
5. Apply an adhesive bandage to the site when hemostasis is achieved, which is not preferred with capillary sampling in children <2 year	147	87.5	21	12.5	0	0.0
6. Discard supplies, being careful to remove all items from the child's bed or cot.	163	97.0	5	3.0	0	0.0
7. Remove the personal protective equipment	100	59.5	68	40.5	0	0.0
8. Perform hand hygiene	50	29.8	118	70.2	0	0.0
9. Monitor perfusion distal to the puncture site after arterial puncture.	34	20.2	43	25.6	91	54.2
10. Documentation	130	77.4	38	22.6	0	0.0
<b>Mean ± SD.</b>	<b>77.45 ± 9.74</b>					

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