Effect of an Educational Program on Nurses' Performance Regarding Vein Finder and Outcomes of Preterm Infants

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Abstract

Background: Vein finder devices are essential tools in neonatal intensive care units, particularly for preterm infants with fragile and hard-to-locate veins. Accurate vascular access is vital for administering medications, fluids, and nutrition. **Aim**: This study aimed to evaluate the effect of educational program on nurses' performance regarding vein finder and outcomes of preterm infants undergoing venipuncture in neonatal intensive care units. **Methods**: A quasi-experimental design was employed. **Setting:** The study was conducted at neonatal intensive care units of Benha Teaching Hospital and Benha Hospital for Health Insurance. It involved a convenience sample of 45 nurses and a purposive sample of 124 preterm infants, divided equally into study and control groups. Data was collected using four tools: I. a structured questionnaire to assess nurses' knowledge, II. Observational checklist to evaluate practical skills, III. Neonatal Infant Pain Scale to assess pain intensity, and IV. a vital signs assessment. **Results**: Post-intervention results showed a significant improvement in nurses' knowledge and practical skills, with a highly significant positive correlation between knowledge and practice scores (p<.01). Preterm infants in the study group who underwent venipuncture using a vein finder experienced significantly lower pain scores and more stable vital signs compared to those in the control group (p<.05). **Conclusion**: The educational program effectively improved nurses' knowledge and practice in using vein finder devices and contributed to improved clinical outcomes for preterm infants. **Recommendation:** These findings support the integration of vein finder training into regular in-service education in neonatal intensive care units.

Keywords: Education program, Nurses' performance, Preterm infants, Vein finder.

Introduction

Preterm birth refers to the delivery of an infant before completing 37 weeks of gestation **(Swarray–Deen et al., 2024).** It is a global health concern, occurring more than three weeks before the expected due date, and is associated with a range of medical complications. Infants born preterm, especially those born very early, often face serious health challenges due to the interruption of critical developmental processes in the final weeks of gestation. These challenges commonly include respiratory distress from immature lungs,

difficulties in regulating body temperature, poor feeding, slow weight gain, and increased susceptibility to infections. Globally, preterm birth and low birth weight contribute to approximately 17% of neonatal deaths, highlighting the urgent need for effective interventions in neonatal care **(Ward et al., 2024).**

The neonatal period, defined as the first 28 days of life, is a particularly vulnerable stage during which newborns undergo essential physiological adjustments for extrauterine life **(Breton-Piette et al.,**

2024). During this time, infants especially those born prematurely require close monitoring and specialized medical support. Neonatal intensive care units (NICUs), also referred to as intensive care nurseries (ICNs), provide this specialized care. These units are equipped to manage high-risk infants who are born prematurely, have low birth weight, or present with congenital or acquired medical conditions requiring intensive monitoring and intervention **(Nazari et al., 2020).**

One of the key clinical challenges in NICUs is achieving reliable vascular access in preterm infants. Their veins are typically small, fragile, and difficult to locate using conventional techniques, increasing the risk of multiple cannulation attempts. Repeated needle sticks not only cause pain and distress but also heighten the risk of complications such as bruising, infection, and long-term vascular damage. In this context, vein visualization technology has emerged as a valuable tool in neonatal and pediatric care **(Arıaslan et al., 2024).**

Vein finders are optical devices designed to enhance the visibility of peripheral veins using near-infrared (NIR) light. The technology operates on the principle that hemoglobin in the blood absorbs NIR light, allowing the device to create a projected image of the underlying vein structure on the skin surface **(Arıaslan et al., 2024; Francisco et al., 2021).** These devices are especially beneficial in clinical settings such as NICUs, where quick and accurate vein access is crucial. Studies indicate that nearly 90% of hospitalized preterm infants require peripheral cannulation for intravenous (IV) treatment, and more than one billion venipunctures are performed annually as part of routine diagnostic and therapeutic care **(Louhith et al., 2024).**

The use of vein finders has demonstrated several clinical benefits, including improved vein detection, reduced procedure time, fewer insertion attempts, and enhanced patient comfort. Vein visualization devices aid healthcare providers in identifying suitable veins for IV catheter insertion and blood sampling, particularly in difficult cases where veins are not visible or palpable. This technology minimizes harm and discomfort, particularly for neonates with delicate vasculature, and increases the likelihood of first-attempt success **(Hoskins et al., 2023; Huang et al., 2020).** Furthermore, vein finders are valuable tools in emergency rooms and adult care settings, providing clearer imaging and enhancing procedural accuracy for patients with challenging vascular access **(Pillai et al., 2025; Forero et al., 2020).**

Nurses play a pivotal role in neonatal care, especially in the administration of IV therapy and blood sampling procedures. Neonatal nurses are highly trained professionals responsible for delivering comprehensive care to newborns during the first month of life. Their responsibilities include assisting physicians with medical procedures, managing and operating specialized equipment, formulating individualized care plans, evaluating treatment outcomes, and educating and supporting families regarding at-home neonatal care **(Shaw et al., 2021).** In the NICU, these nurses serve as essential members of the healthcare team, directly influencing the survival, development, and quality of life of preterm infants **(Girgin & Gözen, 2020; Talus et al., 2023).**

Significance of the study

Peripheral intravenous catheter (PIVC) insertion is a routine yet critical procedure in the care of hospitalized preterm infants. However, the failure rate of PIVC in this population is notably higher compared to other age groups due to their small and fragile

veins. Success in cannulation is strongly influenced by the experience and skill level of the healthcare provider, and failure rates tend to increase when practice is inconsistent or infrequent. In this context, the use of a vein finder can significantly improve the success rate of difficult PIVC insertions by providing enhanced vein visualization **(Chen, 2023).**

Recent studies confirm that vein finder devices significantly improve the success of peripheral venous cannulation. They enhance first-attempt success rates and reduce the number of puncture attempts. This leads to less pain, distress, and procedural time in pediatric and neonatal patients. **Bennakhi et al. (2025)** and **Karaarslan et al. (2025).** found positive outcomes using AccuVein AV500. **Annalyn et al. (2024)** highlighted benefits of NIR imaging techniques. **Hinterstein et al. (2024)** supported Light-Emitting Diodes (LED) transillumination for better vein access.

Despite the growing international evidence supporting the use of vein finders, no prior studies in Egypt have evaluated the effect of training nurses in this technology. Given the critical importance of proper vein access in neonatal care, this gap represents a missed opportunity to enhance nursing practice and patient outcomes. This study, therefore, addresses an essential need by assessing the impact of a structured educational program on nurses' knowledge and practice related to the use of vein finders.

The significance of this study lies in its potential to inform nursing education and clinical practice guidelines. By demonstrating that targeted training can significantly improve nurses' competence in using vein finders, the study advocates for the integration of such programs into routine in-service training in NICUs. Enhancing nurses'

technical skills not only reduces procedural risks and discomfort for preterm infants but also promotes the adoption of evidence-based practices in neonatal nursing. Ultimately, the findings may contribute to the development of standardized protocols for vein finder use in Egypt and support broader efforts to improve the quality and safety of neonatal care.

Aim of the study

This study aimed to evaluate the effect of an educational program on nurses' performance regarding vein finder and outcomes of preterm infants

Research hypotheses:

H^1) Nurses' total score of knowledge will be improved after implementing of an educational program regarding vein finder.

H^2) Nurses' total score of practices will be improved after implementing of an educational program regarding vein finder.

H3) Using vein finder device will improve physiological parameters among preterm infants than traditional venipuncture.

Subjects and Method
Research design:

In the current study, a quasi-experimental research approach was used.

Setting:

The study was carried out in two neonatal intensive care units (NICUs): one on the second floor of Benha Teaching Hospital, which is affiliated with the General Organization for Teaching Hospitals and Institutes and equipped with 15 incubators and a vein finder device; and the other on the third floor of Benha Hospital under the Health Insurance Organization, which has 10 incubators but lacks a vein finder device.

Sample:

The study sample consisted of two groups:

1.   **Nurses:** A convenience sample of all available nurses (n = 45) working in the Neonatal Intensive Care Unit (NICU) at Benha Teaching Hospital during the study period was included. Nurses were selected regardless of age, gender, qualifications, or years of experience.

2.   **Preterm Infants:** A purposive sample of 124 preterm infants receiving care in the NICUs of the study settings over a period of seven months and two weeks was selected based on specific inclusion criteria. The infants were divided equally into two groups:

o **Study group (n = 62):** Preterm infants admitted to the NICU at Benha Teaching Hospital, where the vein finder was used.

o   **Control group (n = 62):** Preterm infants admitted to the NICU at Benha Hospital for Health Insurance, where traditional venipuncture methods were used.

Inclusion criteria:
- Low birth weight (1500 – <2500gm) and not having other health problems.
- Stable Apgar score.

Data collecting tools:
Four tools were employed to achieve the aim of the current study:

Tool (I): A Pre-designed Questionnaire Sheet: It was designed by researchers after reviewing the related literature and reviewed by supervisors. It was written in an Arabic language to gather data in relation to the following parts:

Part I: Nurses' characteristics as age, gender, qualifications, years of experience, working hours, and attended training course regarding vein finder.

Part II: Preterm characteristics and clinical data as gestational age, chronological age, gender, current weight, birth weight, length, head circumference, chest circumference, medical diagnosis, type of labor, Apgar score and length of stay at hospitalization.

Part III: Nurses' knowledge regarding vein finder (Pre/Post): It was designed by the researchers after reviewing related literature as **(Çaglar et al., 2019)** which included MCQ questions to assess nurses' knowledge about vein finder device. These questions were included definition, benefits, how accurate are vein finders in locating veins, aims, uses. Total question (20).

Scoring system:
The nurses' knowledge was assessed using a model answer key. Each response was scored based on its accuracy: a completely correct answer received a score of 2, a partially correct answer received 1, and an incorrect or "don't know" response received 0. The total possible score across the 20 questions was 40 points, representing 100%. These scores were then summed and converted into a percentage. Knowledge levels were categorized as follows:

- **Satisfactory knowledge**: score ≥ 75% (30 to 40 points)
- **Unsatisfactory knowledge**: score < 75% (0 to 29 points)

Tool (II): Observation Checklists (Pre/Post): It was adapted from **Vietnam Ministry of Health, (2018).** It was used to assess nurses' practices regarding using vein finder. Nurses' practices included vein finder warnings (4) steps, precaution (7) steps, cleaning and maintenance (8) steps, product usage (9) steps, charging of vein finder (5) steps, I.V Insertion (15) steps, blood sampling (15) steps.

Scoring system:

Each step of the practice was evaluated as either "done," which was awarded one point, or "not done," which received zero points. The scores were then totaled and converted into a percentage. The full score for the 63 practice steps was 63 points, representing 100%. Practice performance was categorized into two levels:

- **Competent practices**: score $\geq$ 85% (54 to 63 points)
- **Incompetent practices**: score < 85% (0 to 53 points)

Tool (III): Neonatal Infant Pain Scale (NIPS) – for Study and Control Groups:

The NIPS, originally developed by **Lawrence et al. (1993),** was used to evaluate the pain intensity of preterm infants following vein puncture in both the study and control groups. The scale includes six parameters: facial expression, crying, breathing patterns, arm movements, leg movements, and state of arousal.

Scoring System:

Each parameter is rated on a scale from 0 to 2:

- **0** = no response
- **1** = moderate response
- **2** = strong response

The total NIPS score is obtained by summing the scores of all six parameters, with higher scores reflecting greater pain intensity. The pain levels are categorized as follows:

- **Mild pain**: total score 0–2
- **Moderate pain**: total score 3–4
- **Severe pain**: total score greater than 4

Tool (IV): Vital Signs Assessment Sheet (for Study and Control groups): It was used to assess the preterm infant's vital signs, including temperature, respiratory rate, heart rate and blood pressure. It was assessed before and after vein puncture for study and control group then compare between mean of measurement of study and control group.

Pilot Study

A pilot study was carried out involving 10% of the participating nurses (n = 5) and preterm infants (n = 6) from the previously mentioned study setting. The pilot study helped estimate the time required for data collection and identify any potential logistical issues. Based on the results, no changes or deletions were needed, indicating that the tools were suitable for use in the main study.

Content Validity

Content validity of the data collection tools was ensured through expert review. A panel of three professors with expertise in pediatric nursing evaluated the tools for comprehensiveness, accuracy, clarity, and alignment with the study objectives. Their assessments confirmed that the instruments were appropriate and valid for measuring the intended outcomes.

Reliability:

Items	Cronbach alpha	Estimated
A Pre-designed Questionnaire Sheet	0.866	Good reliability
Observation Checklists	0.922	Excellent reliability
Neonatal Infant Pain Scale	0.839	Good reliability
Vital Signs Assessment Sheet	0.765	Acceptable reliability

Ethical Considerations:

Ethical approval for this study was obtained from the Scientific Research Ethical Committee at the Faculty of Nursing, Benha University code of Ethics REC-PN-P70. In addition, formal permission was granted by the General Manager of Benha Teaching Hospital and Benha Hospital for Health Insurance to conduct the research in their respective NICUs.

Prior to data collection, verbal informed consent was obtained from all participating nurses and from the parents or legal guardians of the preterm infants. The researchers provided a clear and simple explanation of the study's purpose, procedures, potential benefits, and the right to withdraw at any time without any consequences. Participation was entirely voluntary, and individuals were assured that there would be no harm or risk involved.

Confidentiality and anonymity were strictly maintained throughout the study. All collected data were handled with care and used solely for research purposes. The study upheld ethical principles, including respect for human dignity, cultural values, autonomy, and privacy of all participants.

Field Work

For nurses

The researchers conducted a training program for nurses providing care to preterm infants in the study group on the use of a vein finder device. The educational program was delivered in four phases: Assessment, Planning, Implementation, and Evaluation.

Assessment phase (Pre):

This phase aimed at gathering baseline data from the participating nurses. The researchers attended Benha Teaching Hospital two days per week (Saturday and Monday) during the morning shift (10:00 AM to 2:00 PM).

Nurses were given a pre-designed questionnaire (Tool I) to assess their knowledge regarding the use of a vein finder. Completing the questionnaire took approximately 30 minutes. The researchers then observed nurses' actual practices using an observational checklist (Tool II) to evaluate their clinical performance. This took around 30 to 45 minutes per nurse. The pre-intervention assessment lasted for four weeks, from the beginning to the end of January 2024. The educational content was tailored based on the identified needs from this assessment.

Planning Phase:

In this phase, the goals and objectives of the educational program were formulated according to the nurses' learning needs identified during the pre-test. The content was reviewed and revised to enhance both theoretical knowledge and clinical skills related to the vein finder. The program was structured into seven sessions and incorporated diverse teaching methods, including modified lectures, group discussions, brainstorming, demonstrations, and re-demonstrations. Various instructional media such as colorful handouts, data shows, and laptops were used to support learning and comprehension. This phase lasted two weeks, from the beginning to mid-February 2024.

Implementation phase:

This phase extended over two months and one week, from the third week of February to the third week of April 2024.

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The participating nurses (n = 45) were divided into five groups, each comprising nine nurses. Each group received seven sessions: 3 theoretical sessions (60 minutes each) 4 practical sessions (60 minutes each). The sessions were delivered in Arabic to accommodate all educational levels. A total of seven hours of training was delivered per group (3 hours theoretical, 4 hours practical). The researchers conducted two sessions per day, totaling four sessions per week.

Evaluation phase (Post):

The evaluation phase lasted four weeks, from mid-April to mid-May 2024, during which nurses' knowledge and practices were reassessed using the same pre-test tools. Following this, from late May to mid-August 2024, preterm infants in the study group were evaluated using the Neonatal Infant Pain Scale and Vital Signs Assessment Sheet to measure outcomes after the educational program.

For preterm infants:

An official approval letter was obtained from the Dean of the Faculty of Nursing, Benha University, to conduct the study at the designated hospitals. Data collection took place over seven and a half months, from January to mid-August 2024. The researchers visited Benha Hospital for Health Insurance (control group) and Benha Teaching Hospital (study group) twice weekly during morning shifts. The study group was assessed after a three-month educational program using the Neonatal Infant Pain Scale and Vital Signs Assessment Sheet. Preterm infants were selected based on inclusion criteria, and clinical data were collected from medical records. Pain and vital signs were assessed before and after venipuncture, with each evaluation taking 3 to 15 minutes.

Statistical analysis:

The collected data were organized, coded, and input into a computer for statistical analysis using SPSS software, version 25. Descriptive statistics, such as frequencies, percentages, means, and standard deviations—were used to describe the demographic and clinical characteristics of the participants. For inferential statistics, the Chi-square (χ^2) test was employed to analyze associations between categorical variables, while the independent t-test was used to compare the mean values of continuous variables between the study and control groups. Furthermore, Spearman's rank correlation coefficient was applied to explore the relationship between nurses' knowledge scores and their practice scores.

Results:

Table (1): Presents that more than one third of studied nurses (35.5%) was over 35 years with mean age is 30.7±1.06 and the majority of them (91.1%) were female. Regarding to qualification less than three quarters (71.1%) of them had a technical health institute. Related to years of experience less than half (46.7%) of them had between 5 and 10 years, and all nurses (100.0%) worked full-time. Also, more than three quarters (82.2%) not attended vein finder training courses.

Figure (1): This figure compares nurses' total knowledge level regarding vein finders pre and post educational program. The figure shows that less than half of studied nurses (42.2%) have satisfactory knowledge level pre-educational program compared to the majority of them (91.1%) post educational program.

Table (2): This table shows nurses' total practice regarding vein finder usage pre and post educational program. Regarding product usage, less than half of studied nurses (44.4%)

have competent levels pre-educational programs compared to the majority of them (95.6%) post educational programs. Also, regarding charging the vein finder, more than half of studied nurses (51.1%) have competent levels pre-educational programs compared to the majority of them (97.8%) post educational programs. In addition, there is a highly statistically significant difference between all items of nurses' total practices regarding vein finder pre and post educational program (p <0.01)

Figure (2): Shows that 60.0% of nurses have competent level pre-educational program compared to 95.6% post educational program.

Table (3): Shows that there was a highly statistically significant positive correlation between total knowledge and total practice scores among nurses pre and post program (r = 0.628, p = 0.001 & r = 0.591, p = 0.000) respectively.

Table (4): Indicates no statistically significant differences in chronological age (p = 0.284), gestational age (p = 0.207), gender distribution (p = 0.577), current weight (p = 0.326), birth weight (p = 0.097), head circumference (p = 0.824), chest circumference (p = 0.202), type of labor (p = 0.278), and Apgar scores at 1st (p = 0.105) and 5th minutes (p = 0.262).

Table (5): reveals that 53.2% of premature had moderate pain level compared to 33.9% of control group. Also, it shows that 61.3% of control group had sever level of pain compared to 35.5% of study group.

Table (6): This table reveals that the mean of respiratory rate of preterm infant in study group after I.V insertion was 46.80±5.48 c/m at p value <0.05, while in control group was 49.36±6.01 c/m at p value <0.01. Also, the mean of systolic blood pressure of preterm infant at study group after I.V insertion was 62.80±8.01 at p value <0.05, while in control group was 66.11±8.51at p value <0.05. Moreover, there was statistically significant difference between study and control groups at p value <0.05 for heart rate and O2 saturation. Meanwhile, there was no statistically significant difference regarding temperature and diastolic blood pressure for study group at p value >0.05.

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Table (1): Distribution of the studied nurses according to their personal characteristics (n=45).

| Items	N	%
Age (Year)		
20 < 25	7	15.6
25 < 30	13	28.9
30 < 35	9	20.0
≥ 35	16	**35.5**
x̄ S.D 30.7±1.06		
Gender		
Male	4	8.9
Female	41	**91.1**
Qualifications		
Diploma of nursing	3	6.7
Technical health institute	32	**71.1**
Bachelor of nursing	8	17.8
Postgraduate	2	4.4
Years of experience		
< 5 years	6	13.3
5 - <10 years	21	**46.7**
10 - <15 years	11	24.4
≥15 years	7	15.6
x̄ S.D 9.2±0.34		
Working hours		
Full time	45	**100.0**
Part time	0	0
Attended training courses about vein finder		
Yes	8	17.8
No	37	**82.2**
If yes what is the number of training courses n=8		
1	8	100.0
2	0	0
3	0	0
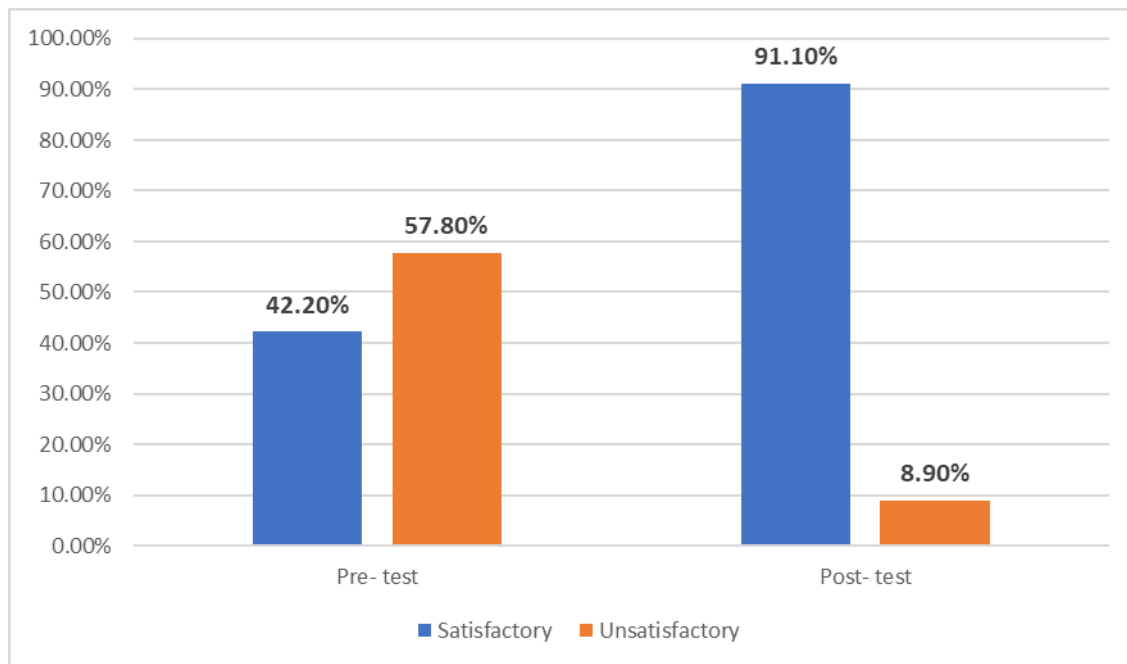
Figure (1): Percentage distribution of studied nurses at pre and post educational program regarding their total knowledge about vein finder (n=45).

Table (2): Percentage distribution of studied nurses at pre and post educational program regarding their total practice about vein finder (n=45).

Items	Pre- test n=45				Post- test n=45				Chi-square	P-value
	Competent		Incompetent		Competent		Incompetent			
	N	%	N	%	N	%	N	%		
Warnings	30	66.7	15	33.3	44	97.8	1	2.2	9.541	.000**
Precautions	24	53.3	21	46.7	42	93.3	3	6.7	12.20	.000**
Cleaning and Maintenance	27	60.0	18	40.0	43	95.6	2	4.4	15.35	.000**
Product Usage	20	**44.4**	25	55.6	43	**95.6**	2	4.4	10.09	.000**
Charging	23	**51.1**	22	48.9	44	**97.8**	1	2.2	13.86	.000**
I.V Insertion	30	66.7	15	33.3	40	88.9	5	11.1	10.64	.000**
Blood sampling	35	77.8	10	22.2	42	93.3	3	6.7	12.77	.000**
Total	**27**	**60.0**	**18**	**40.0**	**43**	**95.6**	**2**	**4.4**	**19.95**	.000**

**: Highly statistically significant

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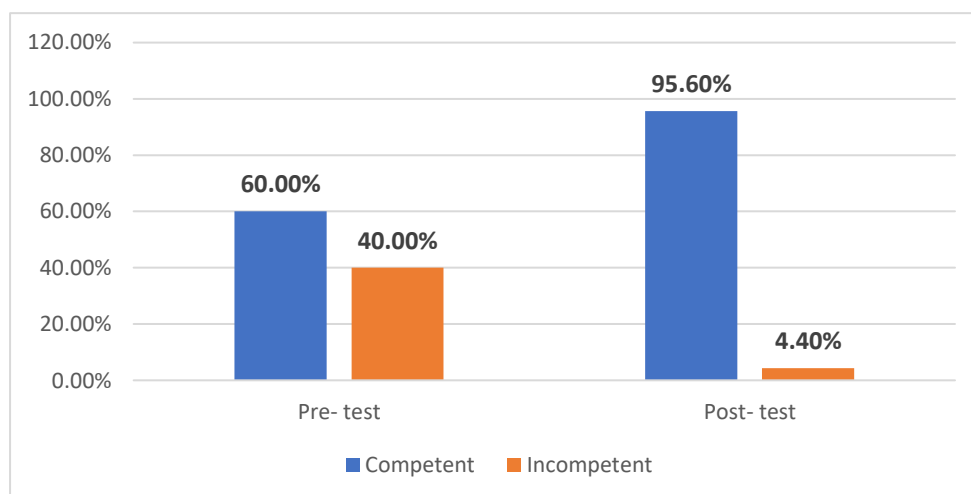

Figure (2): Percentage distribution of studied nurses at pre and post educational program regarding their total practice regarding vein finder (n=45).

Table (3): Correlation between total knowledge and total practice among studied nurses pre and post program (n=45).

	Total practice			
	Preprogram		**Post program**	
Total knowledge	r	p-value	r	p-value
	0.628	.001**	0.591	.000**

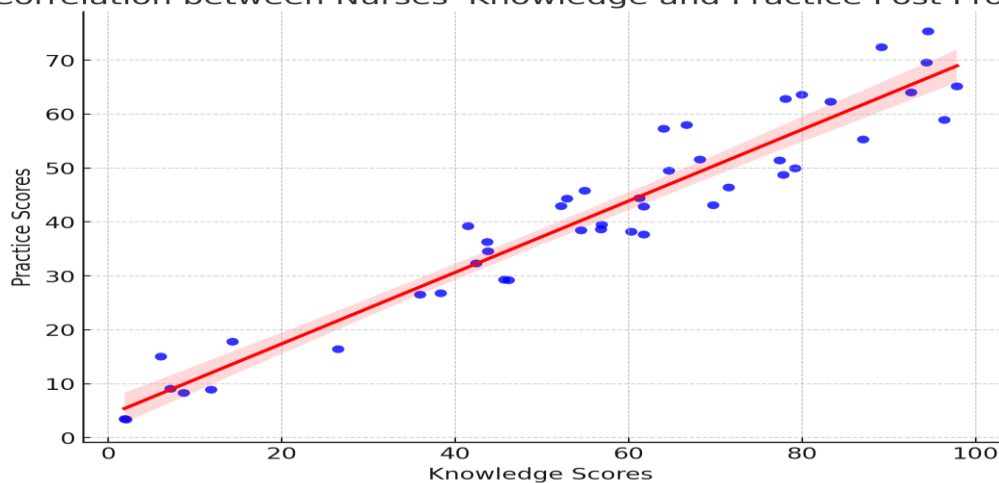(**) Statistically significant at p<0.01. r Pearson correlation

Table (4): Comparison of Preterm Characteristics between Study and Control Groups (n = 62)

Items	Study group n=62		Control group n=62		X^2 / t-test	P-value
	N	%	N	%		
Chronological age (days) M ± SD	5.29±0.99		5.11±0.87		t = 1.075	0.284
Gestational age (weeks) M ± SD	33.71±1.51		33.35±1.65		t = 1.267	0.207
Gender Male Female	25 37	40.3 59.7	28 34	45.2 54.8	X^2 = 0.310	0.577
Current weight (kg) M ± SD	2.16±0.38		2.23±0.41		t = -0.985	0.326
Birth weight (kg) M ± SD	2.03±0.29		2.12±0.31		t = -1.669	0.097
Length (cm) M ± SD	46.1±2.1		45.3±1.9		t = 2.224	0.027*
Head circumference (cm) M ± SD	31.14±1.2		31.09±1.3		t = 0.222	0.824
Chest circumference (cm) M ± SD	30.4±1.1		30.16±0.98		t = 1.282	0.202
Type of labor						
Normal Cesarean section	7 55	11.3 88.7	11 51	17.7 82.3	X^2 = 1.176	0.278
Apgar score 1st min	8.3±0.87		8.52±0.62		t = -1.632	0.105
5th min	9.08±0.41		9.25±0.71		1.136	0.262
Length of stay at hospitalization M ± SD	9.63±2.8		12.1±3.1		t = 4.65	<0.01**

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Table (5): Comparison between the study group & control group regarding their total pain levels (n=62).

Total pain levels	Study group n=62		Control group n=62		Chi-square	P-value
	N	%	N	%		
Sever pain	22	35.5	38	61.3	8.53	0.014*
Moderate pain	33	53.2	21	33.9		
Mild pain	7	11.3	3	4.8		

**: Highly statistically significant

Table (6): Mean score level of vital signs among preterm in study and control groups before and after I.V insertion (n=62).

Items	Study group n=62		T test	P-value	Control group n=62		T test	P-value
	Before	After			Before	After		
	Mean/SD	Mean/SD			Mean/SD	Mean/SD		
Respiratory rate	42.25±4.38	**46.80±5.48**	5.674	<0.05*	41.74±4.68	**49.36±6.01**	8.655	<0.01**
Heart rate	134.1±13.8	138.02±15.6	4.753	<0.05*	133.3±13.2	142.5±16.7	7.057	<0.01**
Temperature	36.08±0.47	36.08±0.47	1.910	>0.05	36.91±0.42	36.91±0.42	1.540	>0.05
Systolic Blood pressure	58.63±7.58	**62.80±8.01**	4.105	<0.05*	58.95±7.25	**66.11±8.51**	4.364	<0.05*
Diastolic Blood pressure	32.46±3.40	33.10±2.99	1.321	>0.05	31.01±2.50	35.24±2.81	4.928	<0.05*
O2 saturation	97.57±2.15	95.20±3.25	3.928	<0.05*	96.44±2.70	93.15±3.95	4.001	<0.05*

*Significant at p <0.05. **Highly significant at p <0.01. Not significant at p>0.05

Discussion:

The findings of this study strongly underscore the beneficial impact of a structured educational program on nurses' performance and knowledge concerning the use of vein finder devices. These devices are particularly valuable in neonatal intensive care settings where preterm infants present unique vascular access challenges due to their small and fragile veins. The study demonstrated a clear improvement in nurses' knowledge and procedural competency post-intervention, aligning with previous literature that highlights the role of education in clinical skill enhancement.

Regarding the characteristics of the nurses studied, the current study mentioned that more than one third of the nurses were over 35 years, and a minority of them had postgraduate educational levels. This finding

was agreed with by **NesalinRose et al. (2019),** who carried out a study about "Assessment of nurses' knowledge and practice regarding the use of transillumination devices for establishing venous access" and found that less than one-third (30%) of the studied nurses were in the age group 27–30 years and the minority of them had master's degrees in nursing. The researchers believed that this age category can easily achieve high-quality nursing care and increase the ability to tolerate the workload.

Regarding total nurses' knowledge level pre educational program, less than half of the studied nurses have a satisfactory level of knowledge regarding the use of vein finders, while the majority were classified as having unsatisfactory knowledge. This finding highlights a significant knowledge gap among nurses concerning the purpose, and importance of vein finder, which could adversely affect clinical practice and preterm outcomes. However, post the implementation of the educational program, there was a notable improvement in nurses' knowledge levels. The majority of participants achieved satisfactory scores, and only a small proportion remained unsatisfactory. This improvement was statistically highly significant (p = 0.000), affirming the effectiveness of the educational program in enhancing nurses' knowledge and competence in utilizing advanced technologies in neonatal care

From the researchers' perspective, this remarkable improvement can be attributed to several factors. First, the educational program provided structured, evidence-based content that directly addressed knowledge deficits identified in the pre-program assessment. Second, the use of interactive teaching strategies and practical demonstrations may have enhanced nurses' engagement, leading to better retention and understanding. Third, the program's focus on the clinical relevance of vein finder uses in preterm infants likely increased motivation to learn, as nurses could directly relate the acquired knowledge to improved preterm outcomes. Collectively, these factors explain the substantial knowledge gains observed and highlight the importance of continuous professional development programs tailored to specific clinical skills.

The results are consistent with finding from study by **Piredda et al. (2024),** entitled "Nurses' evidence-based knowledge and self-efficacy in venous access device insertion and management" who reported a significant post-training increase in nurses' knowledge and self-efficacy related to venous access device management at p value <0.001. This is consistent with our study because both highlight that structured, evidence-based training programs significantly strengthen nurses' knowledge. In addition, our findings are supported by **Weathers et al. (2024),** who reported that only 23% of studied nurses in intervention group had good knowledge about strategies to controlling pain during vein visualization, while improving to 68% post program.

Similarly, **Hassanein et al. (2021),** who carried out a study about "Impact of a structured simulation-based and on-job training program on pediatric peripheral intravenous cannulation" and reported significant improvements in nurses' knowledge: only 4.7% had good knowledge at baseline compared to 25.3% post-training, with sustained improvement at reassessment after two months (20.7%). These findings parallel our study outcomes, further confirming that structured and interactive educational interventions are highly effective in strengthening nurses' knowledge regarding vascular access.

Regarding nurses practice related to blood sampling, the current study revealed a significant improvement in nurses practice related to blood sample. Specifically, adherence to hand hygiene improved from just over one-fifth pre educational program to four-fifths post educational program, while timely specimen delivery increased from one-third pre educational program to more than five-sixths post educational program. These improvements demonstrate not only enhanced technical skills but also greater adherence to infection prevention protocols.

These results confirm prior findings by **Sabaq et al. (2019)** in their study entitled "Effect of Educational Program on Improving Nurses' Performance Regarding Arterial Blood Gases Sampling for Critically Ill Children," which reported that 35% of nurses pre-intervention had satisfactory practice in blood sampling compared with 79% post-intervention. The consistency between the two studies highlights the value of structured educational programs in improving both the technical and safety-related aspects of clinical procedures.

As regards total practice, the current study revealed a substantial overall improvement, as the cumulative competency rate improved from less than two-thirds of studied nurses have competent level of total practice pre-educational program compared to the majority of nurses post-educational program. This finding underscores the effectiveness of the educational program in enhancing clinical practice and ensuring safer, evidence-based care.

These results are consistent with **Stuckey and Curtis (2019)** in their study entitled "Development of a Nurse-Led Ultrasound-Guided Peripheral Intravenous Program" published in the Journal of Vascular Nursing, where 85% of nurses who completed the didactic and hands-on portion of the training achieved a post-test score of greater than 80%. Similarly, the findings are in agreement with **Nti et al. (2025)** which reported that the majority of nurses attained competent practice in using ultrasound-guided peripheral intravenous access following structured training.

From the researchers' point of view, the cumulative improvement in practice observed in the present study suggests that the educational program was successful not only in teaching discrete skills but also in integrating multiple safe practices into nurses' daily routines. This holistic improvement indicates that when training programs combine theoretical knowledge with hands-on application, reinforcement, and feedback, they can foster sustainable changes in behavior.

According to the correlation between total knowledge and total practice pre- and post-educational program regarding vein finders, the results of the current study demonstrate a **highly statistically significant positive correlation** between nurses' total knowledge and total practice scores both **pre-program** (r = 0.628, p = 0.001) and **post-program** (r = 0.591, p = 0.000). These findings indicate that as nurses' knowledge regarding vein finder technology increases, their clinical practice improves correspondingly. This correlation affirms the critical interdependence between theoretical understanding and practical competency in clinical settings.

These findings support those of **Yohannes and Zewdie (2024),** entitled "Knowledge, practice, and associated factors towards intravenous cannula-related infection prevention among nurses working at Northwest Amhara Regional State Comprehensive Specialized Hospitals, Ethiopia," who found that nurses with good knowledge were significantly more likely to

engage in appropriate IV cannula-related infection prevention practices. The implication here is that improving theoretical understanding enhances clinical decision-making and procedural accuracy.

Similarly, **Elbqry (2024)**, in a study entitled "Nurses' Practice and Knowledge of Peripheral Intravenous Cannula Flushing Pre-Therapy Administration at Medical-Surgical Wards" who reported a statistically significant positive correlation between nurses' knowledge and their practice of peripheral intravenous cannula flushing. This reinforces the idea that when nurses understand the rationale behind their actions—such as flushing to prevent blockages or infections—they are more likely to carry out those actions consistently and correctly.

Regarding characteristics of the studied preterm, it was mentioned that the mean gestational age of the study and control groups was 33.71±1.51 and 33.35±1.65 weeks, and more than half of them were female in the study and control groups. Furthermore, the mean current weight was 2.16±0.38 kg & 2.23±0.41 kg of them in the study and control groups. Also, the mean length was 46.1±2.1 & 45.3±1.9 cm in the study and control groups. The current results revealed that there was no statistically significant difference between the study and control groups in gestational age, gender, birth weight, and length at p > .05; therefore, the two groups were similar.

These results are supported by the study performed by **Çaglar et al. (2019)** entitled "Efficacy of Vein Visualization Devices for Peripheral Intravenous Catheter Placement in Preterm Infants," who reported that the mean gestational age of the study and control groups was 33.9±1.53 and 34.3±1.42 weeks, the mean weight was 2152±509 g and

2419±646 g, and the mean length was 44.37±2.44 and 45.0±2.50.

Regarding the neonatal infant pain scale, the current study stated that more than half of the control group experienced severe pain (61.3%) compared to the study group (35.5%), indicating a significant difference between the two groups. These findings disagree with the study conducted by **Arıaslan et al. (2024),** who reported that the mean numerical pain scale (NRS) score in the IVF group was 2.56±1.25, and the control group was 2.94±1.58 (p=0.121). Use of IVF for venous catheterization does not reduce pain and severe pain fear; it only reduces the fear of minor pain and does not affect the success of the procedure.

Also, in cohort with the study done by **Wainer et al. (2017)** entitled "Vein viewing devices for peripheral intravenous cannulation in children: A randomized controlled trial." conducted a randomized controlled trial comparing vein-viewing devices to standard procedures in infants and toddlers. They found no significant reductions in pain, fear, or procedural distress, nor improvements in cannulation time or success rates (p > 0.05). This suggests that, depending on context, practitioner experience, or device type, the benefit against pain may not be universal.

On the other hand, these results are supported by the study performed by **Çaglar et al. (2019),** which reported a significant reduction in pain scores among preterm infants when infrared vein visualization devices were used, with the lowest NIPS scores recorded in the vein finder group compared to the control and transilluminator groups. Their randomized controlled trial emphasized that improved vein localization reduces both the duration and invasiveness of the procedure, thereby reducing behavioral indicators of pain.

Effect of an Educational Program on Nurses' Performance Regarding Vein Finder and Outcomes of Preterm Infants

According to the physiological data, following intravenous insertion indicates that the use of vein finder technology in preterm infants is associated with more favorable and stable vital signs when compared to traditional venipuncture methods. The **respiratory rate** of infants in the study group was significantly lower (46.80 ± 5.48 cycles/min) than that in the control group (49.36 ± 6.01 cycles/min), with p-values < 0.05 and < 0.01, respectively. Similarly, **systolic blood pressure** was lower in the study group (62.80 ± 8.01 mmHg) than in the control group (66.11 ± 8.51 mmHg), with both comparisons showing statistical significance ($p < 0.05$). These results suggest a less pronounced physiological stress response in infants when vein finder-assisted venipuncture is used.

Significant differences were also observed in **heart rate** and **oxygen saturation (SpO$_2$)** between the two groups ($p < 0.05$), further indicating that the infants in the study group experienced reduced procedural distress. In contrast, **temperature** and **diastolic blood pressure** did not differ significantly between groups ($p > 0.05$), suggesting these parameters may be less sensitive to the acute stress of IV insertion or less influenced by the intervention method.

The overall interpretation of these results indicates that the use of vein finder technology plays a protective role in minimizing the physiological impact of IV cannulation among premature infants. By enhancing vein visibility, this technology likely contributes to faster and more accurate venous access, thereby reducing the number of attempts and the duration of the procedure.

These results are coherent with the study conducted by **Çaglar et al. (2019),** who found that infants undergoing IV cannulation with vein visualization devices had significantly lower pain scores and more stable respiratory rates, heart rates, and oxygen saturation levels compared to control groups.

Similarly, **Alizadeh (2021),** who conducted a study about "Comparative Study of Using Vein Finder and Common Venipuncture Method in Anxiety and Psychological Indicators of 3-6-year-olds in the Ward of Pediatric Internal" reported that the use of vein finders during venipuncture in children aged 3–6 years led to improved heart rate stability and reduced anxiety, highlighting the technology's calming effect. Also, **Saju et al. (2019)** further supported this by showing that vein-viewing devices reduce the number of cannulation attempts and procedure duration, which can help limit stress responses and stabilize vital signs. These studies reinforce the conclusion that vein finder devices are effective in improving procedural outcomes and maintaining physiological stability in pediatric patients.

Conclusion:

In conclusion, the implementation of an educational program significantly improved nurses' knowledge and practice in using vein finder devices at NICU. Majority of nurses showed marked improvement in both knowledge and practice. Positive correlation between knowledge and practice. In addition, the study also revealed that the use of vein finders contributed to better clinical outcomes for preterm infants, including reduced pain levels, improved behavioral responses, and more stable physiological parameters during venipuncture.

Recommendations:

☐ Ongoing in-service training programs on the use of vein finder devices should be designed and applied in NICUs, specifically targeting nurses' real learning needs to strengthen their knowledge and skills.

□ Periodic hands-on training sessions should be conducted to reinforce and advance nurses' practical skills in utilizing vein finders effectively within clinical settings.

□ Future research should be conducted using larger and more diverse nurse populations across multiple healthcare settings to validate and generalize the current study's findings.

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تأثير برنامج تعليمى على أداء الممرضات فيما يتعلق بجهاز الكشف عن الأوردة ونتائجة على الأطفال المبتسرين

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الوصول الدقيق للأوعية الدموية للأطفال حديثى الولادة ضروري لإعطاء الأدوية والسوائل والتغذية. لذلك تعد أجهزة الكشف عن الأوردة أدوات أساسية في وحدات العناية المركزة لحديثي الولادة، وخاصة للرضع المبتسرين الذين لديهم أوردة هشة وصعبة. لذا هدفت الدراسة الى تقييم تأثير برنامج تعليمي على أداء الممرضين فيما يتعلق بجهاز الكشف عن الأوردة ونتائجه على الأطفال المبتسرين. و تم استخدام تصميم بحث شبه تجريبي. وقد أجريت هذه الدراسة في وحدتين للعناية المركزة لحديثي الولادة: الأولى في مستشفى بنها التعليمي التابع للهيئة العامة للمستشفيات والمعاهد التعليمية ، والثانية في مستشفى التأمين الصحي ببنها على عينة ملائمة من جميع الممرضين والممرضات المتاحين (٤٥). وعينة غرضية من الأطفال المبتسرين (١٢٤) مجموعة الدراسة ٦٢ مبتسر ومجموعة المراقبة ٦٢ مبتسر. و تم استخدام اربع أدوات؛ الأداة الأولى: أستمارة استبيان مصممة لتقييم معلومات الممرضين، الأداة الثانية: أستمارة الملاحظات لتقييم ممارسات الممرضين، الأداة الثالثة: قياس آلام الرضع حديثي الولادة لتقييم شدة الألم والأداة الرابعة: العلامات الحيوية للأطفال المبتسرين لتقييم العلامات الحيوية للأطفال المبتسرين. واظهرت النتائج ان كان لدى معظم الممرضين مستوى عالٍ من المعلومات والممارسات الكلية بعد تنفيذ البرنامج. وكان لدى معظم الأطفال مستوى عالٍ من الرعاية الذاتية الكلية بعد تنفيذ البرنامج مباشرة والمتابعة بعد شهر واحد على. علاوة على ذلك، كان لدى معظم الأطفال مستوى عالٍ من الكفاءة الذاتية في إدارة مرض السكري الكلية بعد تنفيذ البرنامج مباشرة والمتابعة بعد شهر واحد. لقد حسّن البرنامج التعليمي بشكل فعّال معلومات الممرضين وممارستهن في استخدام جهاز الكشف عن الأوردة وساهم في تحسين النتائج السريرية للأطفال المبتسرين. واوصت الدراسة بدمج جهاز الكشف عن الأوردة ضمن الممارسات الروتينية في وحدات العناية المركزة لحديثى الولادة.