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Assessment of Nurses' Performance Regarding Factors Contributing to Complication of Peripheral Vascular Access Device in Neonatal Intensive Care Unit

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Abstract

Background: Peripheral vascular access device can be associated with complications such as extravascular infiltration, thrombophlebitis, hematoma, catheter-associated blood stream infections, and air embolism. **The study aimed to:** Assess nurses' performance regarding factors contributing to complication of peripheral vascular access device in neonatal intensive care units. **Setting:** This study was conducted at Neonatal Intensive Care Units at Egypt Children Hospital and El-Nasr Hospital, which are affiliated General Authority for Health Insurance. **Design:** A descriptive research design was utilized. **Sample:** A purposive sample of 55 neonatal nurses who were working at the previous mentioned settings. **Tools:** Two tools were used in this study. 1st tool was a Structured Interviewing Questionnaire Sheet to assess characteristics of neonatal nurses, characteristics of the neonates and neonatal nurse's knowledge regarding peripheral vascular access complication, the 2nd tool was Observational Checklist to assess neonatal nurses' actual practices in intensive care units regarding care provided for neonate undergoing peripheral vascular access device insertion. **Results:** The study findings revealed that the great majority of the studied neonatal nurses had a satisfactory total score level of knowledge and only one third of the studied neonatal nurses were competent total score level of practices. **Conclusion:** The great majority of the studied neonatal nurses had satisfactory total score level of knowledge, and only one third of the studied neonatal nurses had a competent total score level of practices and there was no significant correlation between total score level of the studied neonatal nurses regarding factors contributing to complication of peripheral vascular access device knowledge and practice. **Recommendation:** periodical educational programs for neonatal nurses about Peripheral vascular access insertion to improved knowledge, skills to providing high quality of care to neonates.

Key words: *contributing factors, neonatal nurses, neonates and Peripheral vascular access.*

Introduction

Neonates in Neonatal Intensive Care Units **(NICUs)** are considered a vulnerable group to various types of infections, which can enter the child's body in a variety of ways, contributing to the immaturity of the newborn's immune system and the presence of a disease condition that worsens the newborn's immunity especially when the newborn requires care. Intravenous fluids and intravenous medication necessitate the placement of a venous device, either peripheral or central, that serves as a portal for the infection to enter the child's circulation ***(Travier et al., 2021).***,

Intravascular catheters are safe devices routinely used in critically ill children for administration of inotropes, high dose drugs and blood products. Vascular Access Devices **(VAD)** can cause complications, which lead to long hospital stay, morbidity and high mortality. The catheter-related complications can largely be

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preventable through efficient nurses' level of knowledge and practice. Peripheral Vascular Devices **(PVDs)** are a common and essential component of pediatric health care ***(Khadrawi, 2019).***

Peripheral vascular access can be associated with complications such as extravascular infiltration, thrombophlebitis, hematoma, catheter-associated blood stream infections and air embolism ***(Nyamuryekung'e et al., 2021).*** Infection is the most challenging and life-threatening complication of vascular access and causes significant morbidity, loss of access, and mortality. Infections account for approximately 15% to 36% of all death ***(Kaunas, 2019).***

Local complications of IV therapy could develop due to adverse reactions or injury to a vein puncture site, so it is vital that nurses monitor the site for signs and symptoms of phlebitis. Nurses must be provided with regular updates and education on the risk factors, care and maintenance of PVCs. The use of transparent, semi-permeable dressings to secure cannulas provides protection from infection and allows for a visual inspection and assessment of the site **(Etafa, *2020).***

A range of peripheral and central venous devices that provide a route to administer critical and supportive therapies such as antibiotics, nutrition, and chemotherapy exists. Poor choice of VAD can lead to the insertion of an inappropriate device, which reduces treatment efficiency and places the neonates at increased risk of harm. There is a need to make device and insertion decisions that ensure optimum therapy provision while preventing or reducing VAD-related complications (such as infection, thrombosis, and vessel damage), child distress, and treatment delays ***(Paterson et al., 2020).***

The neonatal nurse plays an important role in monitoring the neonate and the catheter site. The neonate's vital signs should be monitored and recorded; the sterile field must be maintained during any handling of the line and the line should be securely fastened to the neonate. The dressing on the central venous site should be changed in accordance with hospital policy and procedures. It should always be changed using aseptic techniques and the catheter site must be closely observed. The nurse usually removes the catheter after the medical practitioner has given an instruction for removing ***(Mohamed et al., 2019).***

Significance of the Study:

In the United States, it is estimated that almost 300 million catheters are used each year, nearly 3 million of which are central venous catheters. The United States estimates that 5% to 10% 0f hospitalized neonate patients develop Central Line Associated Blood Stream Infection **(CLABSI), *(Ullman and Marsh N, 2017).*** Studies have shown that in the United States of America mortality caused by these infection ranges between 12% and 35% depending on causative agent and status of neonate. A study involving France, Germany, Italy and UK countries estimated there were between 8400 to 14,400 episodes of catheter related blood stream infections per years ***(Center for Disease Control and prevention, 2018).***

In Egypt, the incidence of peripheral vascular access complication is unknown but there are approximately 44% of all neonates admitted to the NICU have vascular access complication related to lack of nurses' experience, lack of supplies and facilities ***(Statistical report of El Nasr hospital 2022).*** From the researcher point of view, it`s important to shed the light on assessment of nurses' knowledge and practices regarding factors contributing peripheral vascular access complication in neonatal intensive care units because, neonatal nurses are the primary caregivers for the neonates and have a significant role in providing appropriate care and prevention of vascular access complication.

Aim of the Study

This study aimed to assess nurses' performance regarding factors contributing to complication of peripheral vascular access device in neonatal intensive care units.

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Research questions:

1- What are the nurses' levels of knowledge and practices regarding factors contributing to complication of peripheral vascular access device in neonatal intensive care units?
2- Is there a relation between nurses' knowledge and practices regarding factors contributing to complication of peripheral vascular access device and their characteristics?

Operational Definition

Nursing performance in this study refers to nurses` knowledge and practice.

Subjects and Methods:

Research Design:

A descriptive research design was utilized to achieve the aim of this study.

Research Setting:

This study was conducted at Neonatal Intensive Care Units (NICUs) at Egypt Children Hospital and El-Nasr Hospital that are affiliated to General Authority for Health Insurance. NICU at El-Nasr hospital in the third floor includes six incubators, the total number of neonatal nurses who working at El-Nasr hospital is 13 nurses, about 5 nurses in day shift and 6 nurses in night shift each nurse assigned on 1-2 neonates. NICU at Egypt children Hospital in the fourth floor includes 20 incubators and one radiant warmer, the total number of neonatal nurses whom working at Egypt children Hospital is 42 nurses, with a number of 7 or 8 nurses in the shift each nurse assigned on 1:2 neonates.

Research Subjects:

A purposive sample of 55 neonatal nurses was selected from the previously mentioned settings after fulfilling the following inclusion criteria:

1. Neonatal nurses have experience at least one year.
2. Neonatal nurses aged from 20-45 years.
3. Both genders of neonatal nurses attended to the previously mentioned settings.

Tools of Data Collection:

Two tools were used to collect data as the following:

Tool (1): A structured Interviewing Questionnaire Sheet

A structured interviewing questionnaire sheet was designed by the researcher, after reviewing the current available literature and was written in simple Arabic language to suit level of understanding of neonatal nurses to assess the following:

Part I: Characteristics of nurses: such as age, gender, level of education, years of experience, marital status, training program and the duration of attending training program.

Part II: Characteristics of the neonate: such as (age, gender, gestational age, birth weight, duration of hospitalization, diagnosis and neonates` environment**).**

Part III: Neonatal Nurses` knowledge regarding peripheral vascular access complication:

This part was concerned with the assessment of neonatal nurses' knowledge regarding peripheral vascular access complication such as (definition, predisposing factors, signs and symptom of complication, methods of prevention and role of nurse to prevent complication, purpose from PVAD insertion, complication and important of daily care). It consisted of (8) questions.

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Scoring system:

According to the answers of the study subjects, a correct response was scored 1 and incorrect was scored zero for each area of knowledge. The scores of the items were summed-up and total divided by number of the items, giving a mean score for the items. Regarding the knowledge of the studied neonatal nurses, 100 scores were allocated to all items of the questionnaire. Then the answers were checked with a key answer and accordingly the studied neonatal nurses` knowledge was categorized into two levels: unsatisfactory (< 75) and satisfactory (≥75).

Tool (2): Observational Checklist

It was developed by ***Potter and Perry (2013)*** and modified by the researcher to assess neonatal nurses actual practices regarding care provided for neonate undergoing vascular access device insertion. It included the following (hand washing, vital signs and venous cannula insertion).

Scoring system:

Correct step was scored (2) and incomplete correct was scored (1) and not done was scored (0). These scores were converted into percent score. Competent was scored over 80% and incompetent less than 80%.

Content Validity and Reliability:

The revision of the tools for clarity, relevance, comprehensiveness, understanding and applicability was ascertained by a panel of 3 experts in pediatric nursing specialty from Faculty of Nursing, Helwan University to assess the content validity of the tools. Their opinion was elicited regarding the format, layout, consistency, accuracy and relevancy of the tools and the necessary modifications were done accordingly. Internal consistency and reliability were performed by using Cronbach's alpha –coefficient test.

Scales	Cronbach's alpha
Neonatal nurses knowledge	0.7
Observational Checklist	0.71

Pilot Study:

It was carried out on 10% (5) of neonatal nurses at the Neonatal Intensive Care Unit (NICU) at Egypt Children`s Hospital and El-Nasr Hospital which are affiliated to General Authority for Health Insurance to test the applicability, clarity and efficiency of the tools, and then the necessary modifications of the tools were done according to the results of pilot study. The pilot study had also served to estimate the time needed for each neonatal nurse to fill in the questionnaire. Neonatal nurses under pilot study were excluded from the main study sample.

Field Work

To carry out the study, an approval was obtained from the medical and nursing directors of the Neonatal Intensive Care Units in Egypt Children Hospital and El-Nasr hospital affiliated to General Authority for Health Insurance. Data were collected through 6 months, from the first of July to the end of December (2023).

The researcher was visiting the study setting twice weekly at morning and night shifts by rotation to collect data and implement this study. The researcher first met with the neonatal nurses attending to the previously mentioned settings. The researcher introduced herself to the neonatal nurses. Then, the neonatal nurses were interviewed individually using the previous tools in the predetermined settings. The aim of the study was simply clarified to the neonatal nurses who agreed to participate in the study. The researcher stayed with each neonatal nurse individually about 15-30 minutes to fill in the questionnaire and the researcher used observational checklist to assess neonatal nurses' practices during hand washing, vital signs and venous cannula insertion, filled observational checklist. . The researcher asked the neonatal nurses if had any questions to answer them.

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Administrative Design:

An administrative approval was obtained to carry out the study through an issued letter from Dean of the Faculty of Nursing, Helwan University to the administrator of the study settings explaining the aim of the study in order to obtain their permission and cooperation. An official permission to conduct the study was obtained from the medical and nursing directors of the Neonatal Intensive Care Unit (NICU) in Egypt Children`s Hospital and El-Nasr Hospital which are affiliated to General Authority for Health Insurance . The researcher then met the hospital director and explained the purpose and the tools of data collection.

Ethical Considerations

The ethical research considerations in this study were included the following:-

Prior study conduction, an ethical approval was obtained from the Scientific Research Ethical Committee of Faculty of Nursing, Helwan University. The researcher clarified the aim of the study for the neonatal nurses included in the study. Neonatal nurses' verbal approval was a prerequisite to participate in the study. Neonatal nurses were assured also that all the gathered data were used for the research purpose only and the study is harmless. Also they were allowed to withdraw from the study at any time without giving any reason. Confidentiality of the gathered data and results were secured.

Statistical Design:

Data collected from the studied sample was revised, coded and entered using PC. Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 20. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables and measured standard deviations for quantitative variables. Chi-square test (X^2) was used for comparisons between qualitative variables. Statistical significance was considered at p-value <0.05.

Results:

Table (1): Number and percentage distribution of neonatal nurses according to their characteristics (n=55)

Nurses` characteristics	Number No.	Percentage %
Age in years		
20:<30	40	**72.7**
30:<40	13	23.6
40≤ 45	2	3.6
$\bar{x}$ ± SD(28.9 ± 4.3) years		
Gender		
Male	11	20
Female	44	**80**
Educational level		
Diploma	7	12.7
Higher diploma	43	**78.2**
University	5	9.1
Experience Years of		
1:<5	19	34.5
5:<10	24	**43.6**
10 ≥	12	21.8
Marital status		

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Single	11	20
Married	39	**70.9**
Widow	2	3.6
Divorced	3	5.5
Training programs about vascular access device insertion Previous		
Yes	19	**34.5**
No	36	**65.5**
Since when		
1:<3	4	7.3
3:<5	10	18.2
5≥	5	9

Table (1) showed the nurses` characteristics. This tables indicated that less than three quarters (72.7%) of the studied nurses were in the age group of 20 :< 30 years with $\bar{x}$ ± SD 28.9 = 4.3 years, more than three quarters (80%) of them were female, more than three quarters (78.2 %) were high Diploma degree (technical institute); more than two fifths (43.6%) of them were have 5 < 10 years' experience, more than two thirds (70.9%) of them were married, about two thirds (65.5%) of them did not attend any previous training programs about vascular access device insertion and less than one fifth (18.2%) of them were attended training programs about vascular access device insertion since 3:5 years

Table (2): Number and percentage distribution of the neonates according to their characteristics (n=55)

Characteristics of Neonates	No.	%
Age in days		
<10	35	**63.6**
10: >20	14	25.5
20: ≥30	6	10.9
$\bar{x}$± SD (8.8±7.9) days		
Gender		
Male	37	**67.3**
Female	18	32.7
Gestational age in weeks		
>38	27	49.1
38:≥ 42	28	**50.9**
Birth Weight in kg		
<2.5	19	34.5
2.5<4	34	**61.8**
4≥	2	3.7
Hospital stay in days		
>10	34	**61.8**
10 : > 20	13	23.6
20 : ≥ 30	8	14.5
Diagnosis		
Jaundice Neonatal	19	34.5
Premature	7	12.7
RDS	27	**49.1**
Neonatal sepsis	2	3.7

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Environment of neonate		
Incubator	44	**80**
Radiant	1	1.8
Bed	10	18.2

Table (2) regarding neonates` characteristics, this table clarified that more than half (63.6%) of neonates were in the age group > 10 days with $\bar{x}$ ±SD(8.8±7.9) days, more than two thirds (67.3%)of them were male, about half (49.1%) of neonates were premature, more than half (50.9%)of neonates were appropriate for gestational age, more than half (61.8%) of neonates their birth weight were 2.5: < 4 k.g , more than half (61.8%) of neonates stay in hospital for a periods > 10 days , about half (49.1%) of neonates diagnosed with respiratory distress , neonates` environment is incubator 80% of neonates.

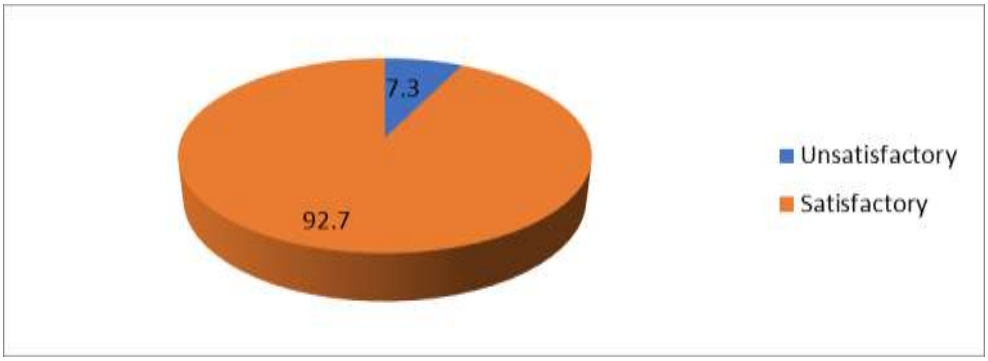

Figure (1) Percentage distribution of the studied neonatal nurses` according to total score level of knowledge about factors contributing to complication of peripheral vascular access device.

Fig (1) showed that great majority ≥ 92.7% of the studied neonatal nurses were Satisfactory total score level knowledge regarding factors contributing to complication of peripheral vascular access device.

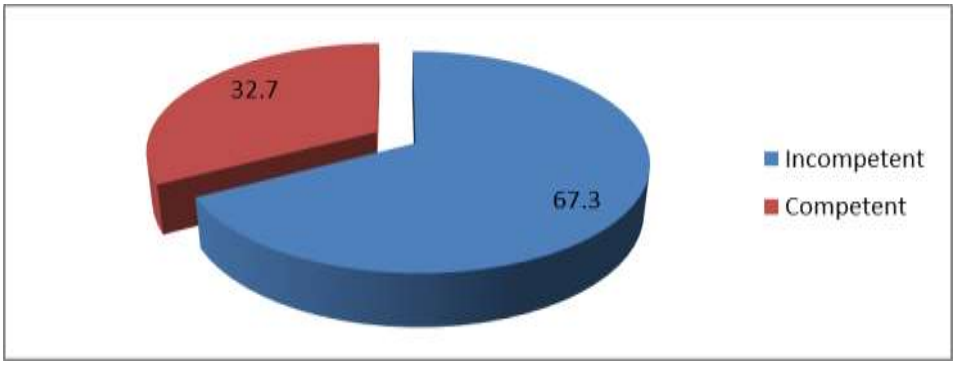

Figure (2) Percentage distribution of the studied neonatal nurses regarding total score level of practices about factors contributing to complication of peripheral vascular access devices

Fig (2) showed that more than two thirds (67.3%) of the studied neonatal nurses had Incompetent total score level of practices about factors contributing to complication of peripheral vascular access device.

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Table (3): Relation between knowledge and studied nurses practice regarding factors contributing to complication of peripheral vascular access device (n=55)

Tools	Practice	
Knowledge	R	p- value
	0.13	0.31

Table (3) illustrated that there is positive (r= 0.13) between neonatal nurses` total reported practice and their knowledge regarding factors contributing to complication of peripheral vascular access device there is no significant correlation between knowledge and practice.

Table (4): correlation between knowledge and the studied neonatal nurses` peported practices regarding factors contributing to complication of peripheral vascular access device (n=55)

Personal data	Knowledge		Practice	
	r	P	R	P
Age	0.05	0.7	0.15	0.26
Gender	0.01	0.99	0.06	0.6
Education	0.02	0.9	0.23	0.09
Experience	0.23	0.08	0.24	0.08

Table 4 revealed that there was a positive correlation between knowledge, practices and all demographic data but the correlation is not statistically significant.

Discussion

This chapter discussed the results of the current study and compared them with other related studies and recent literature, in addition to representing the researcher's interpretations. This study aimed to assess of nurses' performance regarding factors contributing to complication of peripheral vascular access device in neonatal intensive care units.

Regarding the characteristics of the studied nurses, the findings of the current study revealed that almost three quarters of the studied nurses were in the age group of 20 : < 30 years with $\bar{x} \pm SD$ (28.9 ± 4.3) years, most of them were female, more than three quarters were high Diploma degree (technical institute) and more than two fifths of them were have 5 < 10 years' experience.

These findings were similar to some extent to those of the study of **Santos et al; (2020);** in Bahia, Brazil, entitled "Care related to peripheral intravenous catheter in pediatrics performed by nursing technicians" which revealed that most of them were female, half of them worked in the pediatric area from 6 to 10 years and all participant nurses were nursing technicians. From researcher`s point of view, most of the study sample were female because study of nursing in Egyptian universities, secondary school of nursing, and technical institutes was exclusive for females only till few years ago.

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Regarding the characteristics of the studied neonates, the findings of the current study showed that more than half of neonates were in the age group > 10 days, more than two thirds of them were male, about half of neonates were premature, more than half of neonates were appropriate for gestational age, more than half of neonates their birth weight were 2.5: < 4 k.g, about half of neonates diagnosed with respiratory distress.

This result contradict with the findings of the study of **Legemaat et al., (2016)** entitled "Peripheral intravenous cannulation: complication rates in the neonatal population: a multicenter observational study" which notified that the mean birth-weight was 1709 g with a minimum of 365 g and maximum 4540 g. The gestational age (GA) was 31 weeks and 4 days with a minimum of 23 weeks and 6 days and a maximum of 42 weeks and 2 days, the most common diagnosis for admission was prematurity. From the researchers' point of view, these findings may have been because of most neonates need for intensive care unit after delivery may be premature, or have respiratory problem they will need PVAD.

Regarding the total score level of the studied nurses` knowledge about factors contributing to complication of peripheral vascular access devices, the present study showed that great majority of the neonatal nurses were satisfactory about total knowledge. Regarding factors contributing to complication of PVAD This findings were in accordance with of **Ferdianingsih et al; (2022**) " who revealed that the average level of nurses knowledge score with sufficient. From researcher's point of view, most neonatal nurses have an average age of 20 to 30 years. This means that they are recent graduates and have acquired a wealth of information while studying nursing. On the other hand, infection control measurement is written on posters in most hospital area.

Regarding the total score level of the studied neonatal nurses` practice about factors contributing to complication of peripheral vascular access devices, the present study clarified that, more than two thirds of neonatal nurses had unsatisfactory total score of practices. These results were supported by the Egyptian study of **Ouda, et al., (2019),** entitled "nurses knowledge and practices regarding peripheral intravenous cannulation and blood sampling in pediatric Suez Canal University Hospital in Egypt" which revealed that the majority of the studied nurses had unsatisfactory level of practices regarding PIVC and blood sample.

From research point of view, providing quality care for neonatal, especially peripheral vascular access device requires the availability of professional staff, the availability of the necessary medical facility, and adequate training to perform the skills and raise the level of service provision.

Concerning the relation between knowledge and studied nurses' practices regarding factors contributing to complications of peripheral vascular access device, the current study clarified that there was positive relation between neonatal nurses` total reported practices and their knowledge regarding factors contributing to complication of peripheral vascular access device were no significant correlation between knowledge and practice. These results were inconsistent with **Abd El-Fadel et al., (2022)** who studied "Nurses' Knowledge and Practices Regarding Care of Children Undergoing Vascular Access and its Related Complications at Benha in Egypt" and indicated that there was a positive statistical correlation between total level of nurses' knowledge and practice towards care for children undergoing peripheral vascular access.

From researcher point of view, neonatal nurses have medical information and do not use this information in a professional manner, and the hospital environment sometimes does not provide the medical facilities which necessary to complete work tasks.

Regarding the correlation between knowledge of the studied neonatal nurses` and practices about factors contributing to complication of peripheral vascular access device the present study illustrated that total knowledge were high satisfactory while total practices were satisfactory. These results were inconsistent with **Abdel samed et al., (2024)** who indicated that there was a positive correlation between total nurses' knowledge and their total practices regarding intravenous access for neonates.

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Conclusion:

The current study concluded that the great majority of the studied neonatal nurses had a satisfactory total score level of knowledge while more than two thirds of the studied neonatal nurses were incompetent total score level of practices. As well as there was no statistically significant correlation between the studied neonatal nurses knowledge and practices regarding factors contributing to complication of peripheral vascular access device in neonatal intensive care unit.

Recommendations:

In the light of the study findings, the following recommendation are suggested.

- Periodical educational programs for neonatal nurses about peripheral vascular access insertion to help them to update her knowledge and modify her skills.
- Establish evidence –based education programs to improve nurses` knowledge and practices regarding care of peripheral vascular access device.
- Continuous monitoring and evaluating neonatal nurse's practices regarding peripheral access insertion for early detection and prevention of complication
- Further researchers are required involving larger study sample size of neonatal nurses at different study setting all over Egypt and evaluating its impact on health out-come among neonates who insert peripheral access.

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