ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 8, Month: December 2024, Available at: https://hijnrp.journals.ekb.eg/

Assessment of Nurses' Performance Regarding Care of Neonates undergoing Blood Exchange

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Abstract

Background: Almost all neonates develop some degree of hyperbilirubinemia, as a normal transition in their physiology in order to adapt to extrautrine life, and nurses have a vital role in providing care to neonates with hyperbilirubinemia and treated with blood exchange. **Aim**: To assess nurses' performance regarding care of neonates undergoing blood exchange. **Design:** A descriptive research design was used to achieve the aim of this study. **Setting:** This study was conducted at the neonatal intensive care unit of Beni-Suef University Hospital. **Sample:** A purposive sample of 60 nurses was included in the study. **Tools:** Two tools were used to collect the data. **Tool I:** A structured questionnaire sheet to assess socio demographic characteristics, and nurses' knowledge regarding hyperbilirubinemia and blood exchange. **Tool II:** An observational checklist to assess nurses' practices regarding care of neonates undergoing blood exchange. **Results**: 78.4% of the studied nurses had unsatisfactory total level of knowledge. Also, 38.3% of the studied nurses had incompetent total level of practices regarding care of neonates undergoing blood exchange. **Conclusion**: More than three quarters of the studied nurses had unsatisfactory total level of knowledge and also less than half of them had incompetent total level of practices, regarding care of neonates undergoing blood exchange. Also, there was a statistically significant correlation between nurses' total level of knowledge and their total level of practices. **Recommendations:** Periodic educational programs for nurses are necessary to improve nurses' performance regarding the care of neonates undergoing blood exchange.

Keywords: *Blood exchange, Neonatal hyperbilirubinemia, Neonates, Nurses' performance*

Introduction:

A newborn infant or neonate is under 28 days of age, neonatal period is the period within four weeks after birth for both preterm and full-term baby and it is one of the crucial stages and needs more attention for better life. Neonates are observed closely in the first few hours of life. This is particularly true for premature births, which occur before the 37th week of pregnancy, or if there were any complications during the delivery ***(Blackburn, 2017).***

The neonatal period is the period of the most dramatic physiologic changes that occur during human life. While the respiratory and cardiovascular systems change immediately at birth, other organ systems evolve slowly with time until the transition from intrauterine to adult

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physiology. The transitional period of the neonate is a critical time for neonates to adapt to life outside the womb. There are distinct physiologic changes that take place during this period, especially regarding the respiratory and cardiovascular systems. The loss of the low-pressure placenta and its ability to facilitate gas exchange, circulation, and waste management for the fetus creates a need for physiologic adaptation ***(Doherty and Salik, 2020).***

Hyperbilirubinemia is one of the most common physiological disorders occurring in neonates, and most neonates have some visible hyperbilirubinemia in the first week after birth. Hyperbilirubinemia during the first 24 hours of life is pathologic and requires investigation. Bilirubin screening should be done before hospital discharge either transcutaneous or measuring serum levels ***(Perez and Mendez, 2020).***

Severe neonatal hyperbilirubinemia can lead to serious lifelong complications and disabilities such as brain damage, including bilirubin encephalopathy, delayed speech, and motor disorders. These long-term outcomes are not common nowadays due to the availability of timely and effective interventions for hyperbilirubinemia, for example, exchange transfusion, maternal rhesus immunoglobulin prophylaxis and phototherapy. Early detection of neonates predisposed to hyperbilirubinemia can help in preventing and treating these serious complications ***(Boskabadi, et..al, 2020 & Zhang, 2018).***

Blood exchange is the most reliable and effective methord for reduction of bilirubin level in case of hyperbilirubiinemia to prevent kernicterus and anemia. Early exchange reduces the need for subsequent exchange and improves congestive cardiac failure in hydropic neonates. Double volume exchange transfusion is mainly used for the management of hyperbilirubinaemia and haemolytic disease of the neonate, when other methods of treatment such as early and intensive use of phototherapy have been ineffective ***(Chacham, et..al, 2019 & SR, and Gowda, 2016).***

The nurse plays an important role in caring of neonatal hyperbilirubinemia by continual reassessment and evaluation of neonates through, observing skin color, evaluating feeding, elimination pattern, checking placement of eye shields, skin for signs of dehydration, monitoring neonate's temperature. As members of the health care team, nurses share in the responsibility for early detection and identification, family education, management, and follow-up of the mother and neonate. Documentation of the onset of hyperbilirubinemia is essential to differentiate between physiological and pathological hyperbilirubinemia ***(Wong's, 2019).***

Nurses also have a critical role in blood exchange transfusion. Their knowledge and skills are very important for the safety and effectiveness of blood exchange. If they can do it correctly, the probability of incidence of blood exchange risks will be reduced to a minimum. Therefore, nurses should be knowledgeable to make accurate decisions related to their practices, their knowledge is essential to the high quality, safe and effective patient care. So they should assess, plan the necessary intervention, implement, and evaluate transfusion related complications in each step of the blood exchange ***(Akyol, 2019).***

Significance of the study

Neonatal hyperbilirubinemia affects nearly 70% of term and 80% of preterm neonates. Hyperbilirubinemia in near-term and term neonates is a frequent diagnosis that may prompt hospital readmission in the first postnatal week. Hyperbilirubinemia, when severe, can lead to potentially irreversible bilirubin-induced neurotoxicity. Therefore, early identification of neonates at risk for developing severe hyperbilirubinemia has become a public health issue ***(spoorthi, et..al, 2019).***

Globally, researches show that approximately 100,000 neonates, annually, reach extreme hyperbilirubinemia of total serum bilirubin (TSB) ≥ 30 mg/dL requiring blood exchange transfusion. The largest percentage is in low-income countries as in South Asia and Africa ***(Mostafa, et..al, 2017).*** **In Egypt**, severe neonatal

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hyperbilirubinemia accounted for 33% of total admissions to the neonatal intensive care units (NICU), with about 10 cases of kernicterus occurring each year. In a study in Shebin Elkom, Menoufia, on neonatal hyperbilirubinemia, a total of 25/46 neonates (54.3%) developed significant hyperbilirubinemia in the first 5 days of life, and the prevalence of severe hyperbilirubinemia in Menoufia was 17% according to another study. So, this study intended to assess nurses' performance regarding care of neonates undergoing blood exchange**.** ***(Bahgat, et..al, 2016)***.

Operational definition:

Nurses' performance: refers to assessment of nurses' knowledge and practices regarding care of neonates undergoing blood exchange.

Aim of the study:

This study aimed to assess nurses' performance regarding care of neonates undergoing blood exchange**.**

Research questions: -

1- What is the level of nurses' knowledge and practices regarding care of neonates undergoing blood exchange?
2- Is there a relation between the nurses' knowledge, and practices regarding care of neonates undergoing blood exchange and their socio demographic characteristics?

Subject and Methods

I- Technical Design:

The technical design for the study included research design, research setting, subject and tools for data collection.

Research Design:

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

Research Setting:

This study was conducted at the neonatal intensive care unit affiliated to Beni-Suef University Hospital. It consists of 36 units. The neonatal intensive care unit is at the sixth floor of the medical building of the hospital consists of four rooms containing 30 incubators, 3 mechanical ventilators, 10 monitors, nine phototherapy, and 2 servo-heaters. It provides care for preterm, full term, and post term neonates with hyperbilirubinemia and other medical conditions.

Research Subject:

A purposive sample was used to achieve the aim of this study. The study sample consists of 60 nurses working at the previous mentioned setting and provides care to the neonates with hyperblirubinemia and undergoing blood exchange. Nurses have been selected according to the following inclusion criteria;

- Nurses having at least one year of experience.

Tools for data collection:

Two tools were used in this study and were developed by the researcher after reviewing the related literature.

First Tool: Structured Questionnaire

The questionnaire was based on up dated review of related literature. It was adapted from **Elsayed, (2019)** and was written in a simple Arabic language. It was consisted of the following parts:

Part I: Demographic characteristics of the studied nurses: This part includes data about nurses' age, qualification, years of experience, and attendance of previous training courses regarding hyperbilirubinemia.

Part II :Nurses' knowledge regarding hyperbilirubinemia: This part concerned with nurses' knowledge regarding hyperbilirubinemia (definition, normal bilirubin level, dangerous bilirubin level, types of hyperbilirubinemia, timing of appearance of hyperbilirubinemia on the neonate, causes, clinical manifestations, first body organs affected, and management of hyperbilirubinemia).

Scoring system: according to the responses obtained from the studied nurses, a scoring system was followed to assess the nurses' knowledge regarding hyperbilirubinemia. Each question scored **(1)** for correct and complete answer and

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each incorrect answer scored **(0)**. The total degree was **(11)** and then converted into percentage as the following:

Satisfactory knowledge ≥75%

Unsatisfactory knowledge <75%

Part III: Nurses' knowledge regarding blood exchange: This part concerned with questions about blood exchange transfusion (definition of exchange transfusion, indications, team performing the procedure, technique, complications, investigations needed before the procedure, nursing role before, during, and after the procedure, equipment used, size of catheter, catheter testing, precautions).

Scoring system: according to the responses obtained from the studied nurses, a scoring system was followed to assess the nurses' knowledge regarding exchange transfusion. Each question scored **(1)** for correct and complete answer and each incorrect answer scored **(0)**. The total degree was **(13)** and then converted into percentage as the following:

Satisfactory knowledge ≥75%

Unsatisfactory knowledge <75%

Second Tool: Observational Checklist

It was adapted from ***Bowden, (2016)*** and modified by the researcher to assess nurses' practices regarding care provided for neonates undergoing blood exchange. It included all procedures needed for the neonates before, during, and after blood exchange (physical measurement, physiological measurement, and assessing bilirubin level) and nursing procedures needed for neonate undergoing blood exchange transfusion (Preparation for exchange transfusion, care during exchange transfusion procedure, and care after exchange transfusion procedure).

Scoring system: According to the responses obtained from the studied nurses, a scoring system was followed to assess the nurses' practices regarding blood exchange transfusion. Each done step scored **(1)** and each not done step scored **(0)**. The total degree of nurses' practices was **140** (9 scores for assessing neonate's weight, 4 scores for assessing neonate's length, 4 scores for measuring neonate's head circumference, 2 scores for measuring neonate's chest circumference, 9 scores for assessing neonate's body temperature, 7 scores for assessing neonate's pulse, 3 scores for assessing neonate's respiration, 19 scores for assessing neonate's venous bilirubin level, 17 scores for assessing neonate's bilirubin level through heel stick, 22 scores for nursing preparation before the procedure, 35 scores for nursing care during the procedure and 9 scores for nursing care post procedure) and then converted into percentage as following:

Competent practices (≥85%)

Incompetent practices (<85%)

Validity: -

The developed tools were formulated and submitted to five experts in pediatric health nursing to assess the content validity.

Reliability:

Reliability of the tools was tested to determine the extent to which the questionnaire items related to each other. Cronbach's Alpha was be used to determine the internal reliability of the tool. It was (0.826) for knowledge questionnaire and (0.931) for practice checklists.

Ethical Considerations:

An official permission to conduct the study was obtained from the Scientific Research Ethical Committee of Faculty of Nursing Helwan University. The studied nurses were informed that participation in the study is voluntary and subjects were be given complete full information about the study and their role before signing the informed consent. The ethical considerations included explaining the purpose and nature of the study, stating the possibility to withdraw at any time, confidentiality of the information where it would not be accessed by any other party without taking permission of the participants.

II- Operational Item:

Preparatory Phase:

It included reviewing of past, current, national and international related literature and theoretical knowledge

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of various aspects of the study using books, articles, internet, periodicals and magazines to develop tools for data collection.

Pilot study:

The pilot study was carried out at March, 2021 on 10% (6 nurses) of the total study sample (n=60) to examine the clarity of questions and time needed to complete the study tools. Based on the results, no modifications were done. Subjects included in the pilot study were included in the main study sample.

Field work:

The researcher interviewed with the studied nurses before collecting the data of the actual study and introduced herself to nurses. The researcher provided a clear simple explanation regarding the aim of the study to gain their cooperation, Also the researcher assured the nurses about the anonymity of their answers and that the information will be used for scientific research only and will be strictly confidential. The researcher then distributed the questionnaires among the studied nurses and taught them how to fill in the knowledge questionnaire. Each questionnaire took about 20- 30 minutes to be completed. As regards the nurses' practices, they were observed in previously mentioned setting during their actual work in the morning shift. Time consumed for assessing the procedure took 40- 50 minutes according to check list. Data collection of the study was started at the beginning of March 2021 until the end of august 2021.The researcher attended to the previous mentioned setting from 9:00 am to 2:00 pm 2 days/week (Sunday and Wednesday) within 6 months.

III- Administrative Item:

A written approval letter was being issued from Dean of Faculty of Nursing-Helwan University. The letter was being directed to the general manager of Beni-Suef University Hospitals asking for cooperation and permission to conduct this study. After explanation of the study aim, an official permission was obtained from the Dean of Faculty of Nursing and the General Manager of Beni-Suef University Hospitals. Consent was obtained from nurses ensuring complete privacy and total confidentiality.

IV-Statistical Item:

Data was computed and analyzed using Statistical Package for the Social Science (SPSS), version 24 for analysis. The P value was set at 0.05. Descriptive statistics tests as numbers, percentage, mean and standard deviation ($\bar{X} \pm SD$), were used to describe the results. Appropriate inferential statistics such as “F” test or “t” test were used as well. When p-value < 0.05, is considered that there is statistically significant difference. And when p-value < 0.001, is considered that there is highly statistically significant difference.

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Results:

Table (1): Number and Percentage distribution of the studied nurses according to their demographic characteristics (n=60).

Nurses' Characteristics	No.	%
Age / Years		
20-<30	**52**	**86.6**
30-<40	7	11.7
≥40	1	1.7
$\bar{\bar{X}}$ ± SD	**25.8 ± 5.07**	
Qualification		
Diploma of nursing school	11	18.3
Technical nursing institute	**34**	**56.7**
Bachelor in nursing science	10	16.7
Post graduate student	5	8.3
Years of experience in the neonatal intensive care unit		
1-<5	**47**	**78.3**
5-10	8	13.3
>10	5	8.3
Attendance of previous training courses		
Yes	28	46.7
No	**32**	**53.3**

Table (1): clarified that 86.6% of the studied nurses were in the age group 20-<30 years with $\bar{\bar{X}}$ ± SD 25.8 ± 5.07. More than half (56.7%) of them were graduated from technical nursing institute. Also, 78.3% of the studied nurses had 1< 5 years' experience in the neonatal intensive care unit. As well as, 53.3% of them hadn't attended previous training courses regarding neonatal hyperbilirubinemia

Table (2): Number and Percentage distribution of the studied nurses' total level of knowledge regarding care of neonates undergoing blood exchange (n=60).

Nurses' total knowledge	No.	%
Unsatisfactory knowledge <75%	47	78.4
Satisfactory knowledge ≥ 75%	13	21.6
Total	60	100%

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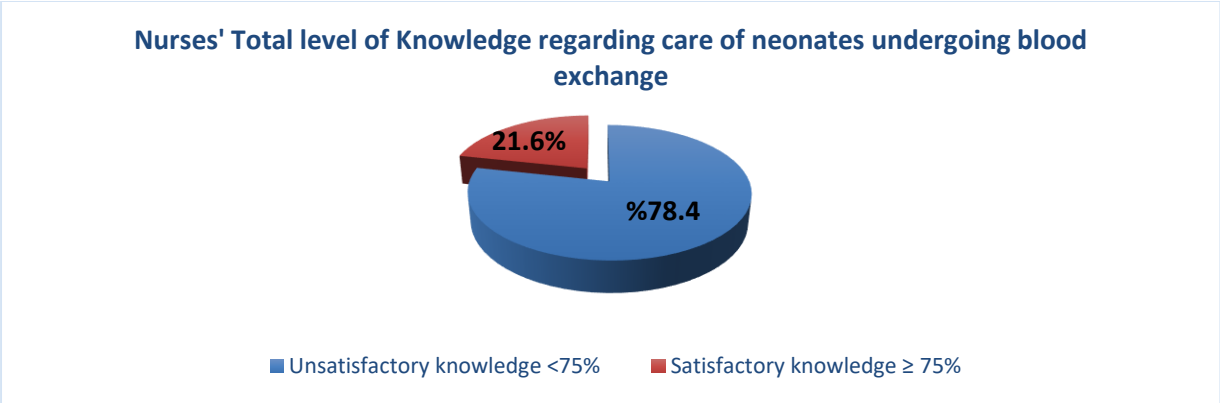

Figure (1): Percentage distribution of the studied nurses' total level of knowledge regarding care of neonates undergoing blood exchange (n=60).

Table (2) & figure (1): Showed that 78.4% of the studied nurses had unsatisfactory total level of knowledge, While, only 21.6% of them had satisfactory total level of knowledge regarding care of neonates undergoing blood exchange.

Table (3): Number and Percentage distribution of the studied nurses' practice regarding care of neonates undergoing blood exchange (n=60).

Nursing practices	Competent		Incompetent	
	No.	%	No.	%
Measurement of neonate's weight	**51**	**85**	9	15
Measurement of neonate's Length	43	71.7	17	28.3
Measurement of neonate's head circumference	41	68.3	19	31.7
Measurement of neonate's chest circumference	**60**	**100**	0	0
Assessment of neonate's body temperature	**48**	**80**	12	20
Assessment of neonate's apical pulse	37	61.7	**23**	**38.3**
Assessment of neonate's respiration	**58**	**96.7**	2	3.3
Bilirubin level (venous blood sample)	47	78.3	13	21.7
Bilirubin level (Heel stick)	42	70	18	30
Nursing preparation for blood exchange transfusion	31	51.3	19	31.7
Nursing role during blood exchange transfusion procedure	46	76.7	14	23.3
Nursing role after blood exchange transfusion procedure	39	65	21	35

Table (3): Illustrated that 100% of the studied nurses had competent practices regarding measuring chest circumference, 96.7% of them had competent practices regarding assessment of respiration. Moreover, 85% of them had competent practice regarding measuring weight and 80% of them had competent practice regarding assessing temperature.While, 38.3% of them had incompetent practice regarding assessment of neonate's apical pulse.

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Table (4): Number and percentage distribution of the studied nurses' total level of practices regarding care of neonates undergoing blood exchange (n=60).

Nurses' total practices	No.	%
Incompetent practices <80%	23	38.3
Competent practices ≥80%	37	61.7
Total	60	100%

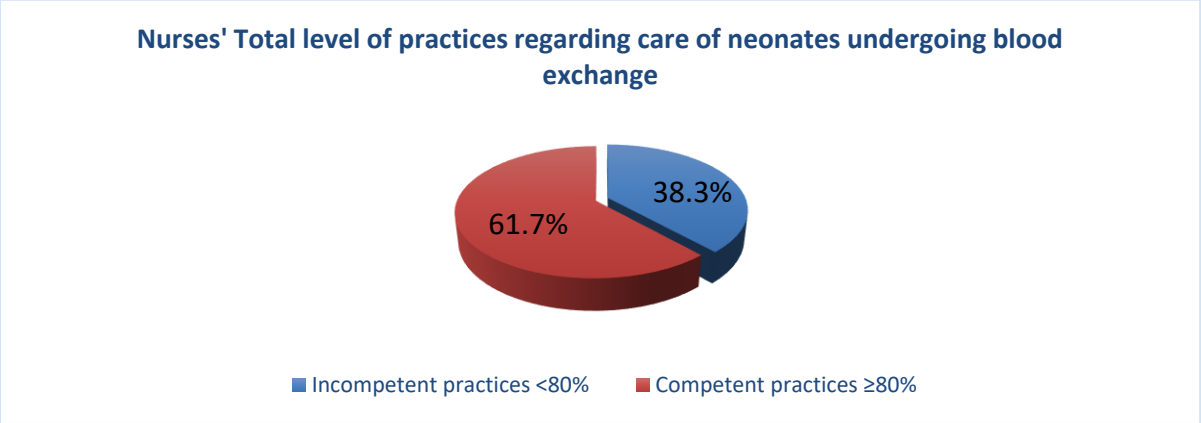

Figure (2): Percentage distribution of the studied nurses' total level of practices regarding care of neonates undergoing blood exchange (n=60).

Table (4) & figure (2): Revealed that 61.7% of the studied nurses had competent total level of practices. While 38.3% of them had incompetent total level of practices.

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Table (5): The relation between nurses' total level of knowledge and their demographic characteristics (n=60).

Personal characteristics	No.	Unsatisfactory knowledge		Satisfactory knowledge		X^2	P-Value
		No.	%	No.	%		
Nurses' age/Years							
20-<30	52	40	66.7	12	20	5.61	.048*
30-<40	7	6	9.9	1	1.7		
≥40	1	1	1.7	0	0		
Qualification							
Diploma of nursing school	11	10	16.7	1	1.7	8.14	.027*
Technical nursing institute	34	25	41.7	9	15		
Bachelor in nursing science	10	8	13.2	2	3.3		
Post graduate student	5	1	1.6	4	6.6		
Years of experience							
1-<5	47	35	58.3	12	20	11.8	.009*
5-10	8	8	13.2	0	0		
>10	5	4	6.6	1	1.7		
Attendance of previous training courses							
Yes	28	17	28.3	11	18.3	7.04	.022*
No	32	8	13.3	24	40		

Table (5): Illustrated that, there is a statistically significant relation between nurses' total level of knowledge and their age, educational level, years of experience, and attending training courses about neonatal hyperbilirubinemia.

Table (6): The relation between nurses' total level of practices and their socio demographic characteristics (n=60).

Personal characteristics	No	Incompetent practices		Competent practices		X^2	P-Value
		No	%	No	%		
Nurses' age/ Years							
20-<30	52	20	33.3	32	53.3	3.18	.256
30-<40	7	3	5	4	6.7		
≥40	1	0	0	1	1.7		
Qualification							
Diploma of nursing school	11	3	5	8	13.3	9.43	.028*
Technical nursing institute	34	15	25	19	31.7		
Bachelor in nursing science	10	3	5	7	11.7		
Post graduate student	5	2	3.3	3	5		
Years of experience							
1-<5 years	47	19	31.7	28	46.7	1.64	.707
5-10 years	8	2	3.3	6	10		
>10 years	5	2	3.3	3	5		
Attendance of previous training courses							
Yes	28	11	18.3	17	28.3	12.08	.015*
No	32	12	20	20	33.3		

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Table (6): Illustrated that, there is a statistically significant relation between nurses' total level of practices and their educational level and attending training courses about neonatal hyperblirubinemia while there is no statistically significant relation between nurses' total level of practices and their age and years of experience.

Table (7): The correlation between nurses' total level of knowledge and their total level of practices (n=60).

Study variables		Total knowledge	Total practices
Total knowledge	**R**	1	.269
	P	-	.016*
Total practices	**R**	.269	1
	P	.016*	-

Table (7): Illustrated that, there is a statistically significant correlation between nurses' total level of knowledge and their total level of practices.

Discussion:

Hyperblirubinemia may become severe enough to put neonates at risk for bilirubin-induced mortality or long-term neurodevelopmental impairments necessitating effective evaluation and treatment ***(Olusanya, et..al, 2018).*** Blood exchange transfusion was introduced in the late 1940s to decrease mortality and morbidity associated with hemolytic disease of the neonate, but subsequently, it was used for the treatment of severe hyperbilirubinemia due to any cause ***(Chacham, et..al, 2019).***

Nurses play a vital role in coordinating communication among all members of the neonate's care team, including physicians, laboratory personnel and parents. Also, one of the most integral nursing cares for neonatal hyperbilirubeinemia is the care during blood exchange. Proper nursing care enhances the effectiveness of exchange transfusion and minimizes its associated complications. Providing care to neonates with hyperbilirubinemia is a condition that requires safe knowledge and skills to achieve optimal health outcomes. Consequently, neonatal nurses should acquire advanced up to date knowledge and practices to save neonate's life. ***(Ramdan, et..al, 2019)***.

This study aimed to assess nurses' performance regarding care of neonates undergoing blood exchange.

Regarding to the characteristics of the studied nurses the present study revealed that the majority of the studied nurses were in the age group 20- <30 years. This finding was in an agreement with **Abd El Galil, (2019)**, who conducted a study at Mansoura, Egypt which entitled (Monitoring Quality of Nursing Care in Neonatal Care Units at Hospitals, affiliated to Ministry of Health, Dakahlia Governorate) and found that more than three quarters of the studied nurses were in the age group from 20 years to less than 30 years. In the researcher's opinion, this may be due to that the younger age group is usually selected to work in the critical units.

In addition, the current study revealed that more than half of the studied nurses were graduated from technical nursing institute. This finding was disagreed with **Ramdan, et..al, (2019),** who found that more than three quarters were graduated from secondary school of nursing. In the researcher's opinion this may be due to the fact that currently, all nurses graduated from nursing secondary schools, obligatory, complete their study at nursing and technical institutes of nursing.

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As regard years of experience, the current study revealed that more than three quarters of the studied nurses had 1< 5 years' experience in the neonatal intensive care unit. This finding was in an agreement with **Ahmed & Hani, (2017),** who conducted a study at Minia, Egypt which entitled (Assessment of Nurse's Knowledge and Practice Working in District Hospitals at Minia Governorate about Neonatal Hyperbilirubinemia), who found that more than two third of the studied nurses have experience less than 5 year.

As regarding indications of blood exchange procedure, the current study revealed that more than two thirds of the studied nurses had satisfactory knowledge regarding indications for blood exchange for neonatal hyperblirubinemia. This finding was agreed with **Ree, et..al, (2021),** who conducted a study at Leiden, the Netherlands which entitled (Exchange Transfusions in Severe Rh Mediated Alloimmune Haemolytic Disease of The Foetus and Newborn: A 20-Year Overview On The Incidence, Associated Risks And Outcome) and mentioned that more than two thirds of the studied nurses had insufficient knowledge regarding the indications for blood exchange in neonates.

Regarding the nurses' total level of knowledge, the current study revealed that more than three quarters of the studied nurses had unsatisfactory total level of knowledge regarding neonatal hyperblirubinemia. This finding was supported with **Ibrahim, et..al, (2019)** who found that three quarters of the studied nurses scored unsatisfactory knowledge regarding hyperblirubinemia. In the researcher's opinion this may be due to the shortage of health education provided to nurses by the qualified healthcare professionals.

Regarding nurses' total level of practices related to care of neonates undergoing blood exchange, the current study revealed that more than half of the studied nurses had competent total level of practices regarding blood exchange procedure. This finding was in an agreement with **Piri et..al. (2018)**, who conducted a study at Iran which entitled (Blood Exchange-Related Nursing Care in Neonatal General and Intensive Care Units), who mentioned that more than half of nurses had satisfactory level of practice regarding to care of hyperblirubinemiad neonates undergoing blood exchange.

Also, the current study revealed that less than half of the studied nurses had incompetent total level of practices regarding blood exchange procedure. This finding agreed with **Mukhlif & Neamah, (2021)** who conducted a study at Baghdad which entitled (Effectiveness of an Educational Program on Nurses' Practices about Blood Exchange Transfusion Procedure in Neonatal Intensive Care Unit in Al–Ramadi Teaching Hospital for Maternity and Children) who found that half of nurses have poor practices about blood exchange transfusion procedure. In the researcher's opinion, this may be due to lack of motivation of nurses to up-to-date their practices.

The current study revealed that there is a statistically significant relation between nurses' total level of knowledge and their age, educational level, years of experience, and attending previous training courses about neonatal hyperblirubinemia. This finding was approved with **Khudhair, (2018)** who conducted a study at Cairo, Egypt and entitled (Assessment of Nurses Knowledge Regarding Hyperblirubinemia in Basra Hospitals) who stated that there is a statistically significant relation between nurses' total knowledge and their socio demographic characteristics namely age, educational level, years of experience, and attending training courses about neonatal hyperblirubinemia. In the researcher's opinion, this result may explained as; knowledge levels were low in nurses who have decreased year of experience and knowledge levels were high in nurses who have increased year of experience.

Concerning the total level of practices of the studied nurses, the current study revealed that, there is a statistically significant relation between nurses' total level of practices and their educational level and attending previous training courses about neonatal hyperblirubinemia. This finding was approved with **Abdel**

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Khalek, (2019) who studied "The Impact of an Educational Program on Nurse's Knowledge and Practices regarding Neonatal Hyperblirubinemia" at Cairo, Egypt and concluded that, there was a highly statistically significant relation between nurses' total practices and their socio demographic characteristics namely educational level and attending training courses about neonatal hyperblirubinemia. In the researcher's opinion, this s could be interpreted as; practice levels were low in nurses who didn't attend previous training courses and knowledge levels were high in nurses who attended previous training courses.

The current study revealed that there is no statistically significant relation between nurses' total level of practices and their age and years of experience. This finding was in agreement with **Mohamed, (2020)**, who studied (Quality of Nursing Care for Neonates with Respiratory Distress Syndrome) at Benha, Egypt and found that there was no statistically significant relationship between nurses' practice and their age and years of experience.

The current study illustrates that, there is a statistically significant correlation between nurses' total level of knowledge and their total practice. This finding was in the same line with **(Santhi, 2020)** who conducted a study at Indian which entitled (A Study to Assess the Effectiveness of Protocol on Care of Newborn in Phototherapy on Knowledge and Practice among Nurses at Selected Hospitals in South India) who concluded that there was a statistically significant correlation between the studied nurses' total knowledge and their total practices.

Conclusion

Based on the results, it can be concluded that, more than three quarters of the studied nurses had unsatisfactory total level of knowledge regarding neonatal hyperbilirubinemia and exchange transfusion, and also less than half them had incompetent total level of practices regarding exchange transfusion procedure. Meanwhile there was a statistically significant relation between nurses' total knowledge and their age, educational level, years of experience, and attending previous training courses regarding neonatal hyperbilirubinemia. And also, there was a statistically significant relation between nurses' total level of practices and their educational level and attending previous training courses regarding neonatal hyperbilirubinemia. Also, there was a statistically significant correlation between nurses' total level of knowledge and their total level of practices regarding care of neonates undergoing blood exchange.

Recommendations

In the light of the study findings, the following recommendations are suggested

- Periodic educational programs for nurses are necessary to improve nurses' performance regarding infection control and the procedure of exchange blood exchange for neonates with hyperbilirubinemia.
- Dissemination of a procedure book based on evidence-based practice containing all nursing competencies related to blood exchange for neonates with hyperbilirubinemia.
- Further studies should be conducted to improve nurses' awareness regarding evidence-based practices for blood exchange for neonates with hyperbilirubinemia.

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