

Enhancing Neonatal Nurses' Performance Regarding Early Detection of Neurological Dysfunction among Neonates having Hyperbilirubinemia

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Abstract: Neonatal hyperbilirubinemia is the most common health hazard of neonates which have toxic effects on the brain and cause serious complications. Nurses' apply the bilirubin induced neurological dysfunction tool for early detection of neurological dysfunction have decrease incidence of neurological dysfunction among neonate having hyperbilirubinemia. Aim of the study was to enhance nurse's performance regarding early detection of neurological dysfunction among neonates having hyper-bilirubinemia. Research design: A quasi experimental study was utilized. Research settings the study was conducted in neonatal intensive care units at Benha University Hospitals and Specialized Children Hospital in Benha City. subjects: (50) nurses who work in the previous mentioned settings and (100) neonates were selected. Tools of data collection *1st tool* Interview questionnaire sheets were used to collect the participants' characteristic data and knowledge of the studied nurse regarding hyperbilirubinemia, *2nd tool:* observational checklist about Bilirubin- induced neurological dysfunction tool to assess nurses' performance for early detection of neurological dysfunction. Results: The present study indicated that nurses' knowledge about hyperbilirubinemia and application of bilirubin induced neurological dysfunction tool. In pretest was unsatisfactory but their knowledge in posttest improved after provision of instructional guidelines and there was a statistically significant difference between mean scores of nurses' skills before and after application of instructional guidelines about application of bilirubin induced neurological dysfunction tool. Recommendation: It was recommended that, neonatal intensive care units should provide training courses for nurses about hyperbilirubinemia and application of bilirubin induced neurological dysfunction tool and adequate supervision and follow up.

Keywords: Neonatal Nurses; Neurological Dysfunction; Hyperbilirubinemia.

I. INTRODUCTION

Neonatal jaundice is a unique disease of newborn with the main characteristics that yellowing of the skin, sticky membranes, sclera and other tissues of a newborn infant. Generally, it can be basically divided into two categories based on the clinical manifestations: physiological jaundice, which would subside in the short term after birth; pathologic jaundice, the neonatal jaundice of infant aggravated with time and could not be subsided. Moreover, serious pathological jaundice could cause kernicterus which affect the development of wisdom and neurological of newborn infant in post neonatal period (Dani et al., 2015).

The jaundice is usually due to unconjugated hyperbilirubinemia, which is neurotoxic and can cause kernicterus or even death in newborns. Kernicterus is characterized by bilirubin staining of the basal ganglia and involves diffuse neuronal damage. The precise blood level above which unconjugated bilirubin will be toxic for an individual infant is unpredictable. However, high incidence of kernicterus is associated with serum bilirubin levels in excess of 20 mg/dl in normal birth weight babies who are otherwise healthy. There is no cure for kernicterus, can be prevented if jaundice is recognized early and effective therapy commenced promptly (*Testoni et al., 2015*).

Bilirubin- Induced Neurological Dysfunction (BIND) refers to the clinical signs associated with Bilirubin toxicity (ie, hypotonia followed by hypertonia and/or opisthotonus or retrocollis). Around 55-65% the babies with BIND, presents with these features, 20-30% may display some neurologic abnormalities, and approximately 15 have no neurologic signs. Acute Bilirubin Encephalopathy (ABE) can be divided into 3 stages first phase (first few days of life) is characterized by decrease in alertness, hypertonia and poor feeding are the typical signs. The second phase (variable onset and duration) hypertonia of the extensor muscle is a typical sign infants present clinically with retro Collis (backward arching of the neck), opisthotonus, or both. Third phase (infants aged >1 wk).hypertonia is atypical sign (*Ragab, 2012*).

Early signs of ABE are subtle and nonspecific and be missed. They need to be elicited by direct questioning of parents and close clinical observation. During the early phases of BIND prompt, effective intervention can prevent chronic kernicterus sequelae. BIND that progresses to scores between 4 and 6 is often reversible (*Bhutani et al., 2008*).

In this scoring system, characteristics of mental state, muscle tone, and cry are grouped into three levels of increasing abnormality: stage IA, minimal signs; stage IB, progressive but reversible with treatment; stage II, advanced and largely irreversible, but may be significantly decreased by treatment. Characteristics for each category are given a weight of 1, 2, or 3 according to their severity and then summed for an overall score. Greater risk is associated with higher numbers (0–9). (*Johnson et al., 2014*)

Most infants who develop kernicterus have manifested some or all of the signs of acute bilirubin encephalopathy. However, infants may develop kernicterus without having exhibited signs of acute bilirubin encephalopathy.

The nurse play a critical role in identifying the neonate at risk, providing parent education and support, and providing nursing care to the neonate undergoing treatment for hyperbilirubinemia the nurse coordinates of communication among all members of the neonate's care team, including physicians, parents and laboratory personnel (*Ball & Bindler, 2006*).

Significance of the study:

Neonatal jaundice is still a leading cause of preventable brain damage physical handicap, and early death among infants in many communities. Greater awareness is need among all health workers. Delaying treatment of hyperbilirubinemia lead to serious neurological complication for neonates. Through clinical practice, some of these neonates were developed acute signs of bilirubin encephalopathy especially lethargy and refuse of feeding these signs need close observation to be recognized, identified and documented because its subtle and nonspecific and may be missed in early stage of bilirubin encephalopathy the application of BIND tool might be help in early detection of neurological dysfunction.

Nurses' apply the BIND for early detection of neurological dysfunction decrease incidence of neurological dysfunction among neonate having hyperbilirubinemia.

The researcher observe that nurses in NICUs do not know about BIND tool and how to apply it and consequently provide inappropriate nursing intervention and inaccurate recording and reporting about BIND tool and its degree.

Aim of the study: This study was aimed to enhance neonatal nurses' performance regarding early detection of neurological dysfunction among neonates having hyperbilirubinemia this will be achieved through:

1. Assessing nurses' performance about the application BIND tool.
2. Design, implement and evaluate the instructional guidelines for early detection of neurological dysfunction.

Research hypothesis: Instructional guidelines will enhance neonatal nurses' performance regarding early detection of neurological dysfunction among neonates having hyperbilirubinemia.

II. SUBJECTS AND METHODS

The methodology followed for achieving the aim was elaborated under the following four main designs namely:

- I. Technical design
- II. Operational design
- III. Administrative design
- IV. Statistical design

I- Technical Design

The technical design for the study includes research design, setting of the study, subjects, and tools for data collection.

Research Design:

A quasi experimental study was utilized for conducting the study.

Research Settings:

This study was carried out at Neonatal Intensive Care Units (NICUs) at Benha University Hospitals and NICUs in Children Specialized Hospital affiliated to Ministry of Health and Population (MOH) at Benha City this sitting having the highest capacity of nurses and neonates suffering from hyperbilirubinemia.

Subjects:

Sampling type & technique:

A purposive sample consisted of the following:-

- 50 NICUs' nurses with different categories working in the previously mentioned setting.
- (100) neonates who were available at the time of data collection from beginning of March 2018 to end of May 2018, and diagnosed as hyperbilirubinemia.

Inclusion criteria:

Neonatal intensive care units of nurses was included in the study after fulfilling the inclusion criteria.

- Bed side nurse
- At least one year of experiences.

Neonates were included in the study after fulfilling the inclusion criteria which ware:

- Gestational age 34 weeks or more
- Total serum bilirubin 20mg/dl or more on admission
- < 14 days of life
- Neonates without congenital anomalies

Tools of data collection:

Data were collected through the following tools:

I- A questionnaire format. It was designed in simple Arabic language by the researcher and revised by supervisor. It consists of the following two parts:

Part I: It was concerned with the characteristics of the studied nurses, as regards their age, level of education, years of experience and attendance of previous training programs about management of hyperbilirubinemia and characteristics' of the studied neonates as gestational age, gender, types of delivery, types of feeding.

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Part II: it was related to assess nurses' knowledge about hyperbilirubinemia such as: definition, causes, importance of assessing neurological function, **BIND** tool definition, and component. This tool was used as pretest and posttest.

Scoring system of nurses' knowledge:-

The total score for the questionnaire formats was "128" marks.

The nurses' answers were categorized into:

- Score > 85%, referred to satisfied knowledge.
- Score less than 85% referred to unsatisfied knowledge.

II. An Observational Checklist for BIND: It was adopted from **Bhutani (2006)** used to assess nurses' performance for early detection of neurological dysfunction this observational checklist was translated Arabic to be easily understood and used by nurses. The observational checklist about **BIND** tool includes 3 parts to assess: Mental status, Muscle tone and Cry pattern.

Mental status includes 3 items, Muscle tone includes 3 items and Cry pattern includes 3 items.

Numeric values are assigned to the levels of each category and started from 0-3 in mental status, from 0-3 in Muscle tone and from 0-3 in Cry pattern

- Total Score of Score of **BIND** tool 9.
- Score of 7-9 represent advanced ABE: urgent, prompt and individualized interventions are recommended to prevent further brain damage, minimize severity of sequelae and possible reverse acute damage.
- Score of 4-6: represent moderate ABE and are likely to be reversible with urgent and prompt bilirubin reduction strategies.
- Score of 1-3: are consistent with subtle signs of ABE in infants with HB.

Scoring System of Observational Checklist on BIND tool: An observational checklist on **BIND** tool included 3 parts; the Total numbers of items in the observational checklist were 9 items. Regarding skills of the nurses in the observational checklist in each part every item done correctly and accurately was giving 1 score and each item not done/or done inaccurately was giving 0 score. All of them to re-demonstrate application of **BIND** tool upon regarding to total skills' scores of the observational. Checklist was 9 scores, the scores of the items were summed up and the total divided by the number of the items. Nurses get scores from 0-5 were considered having incompetent skills. Nurses get scores from 6-9 were considered having competent skills.

Instructional Guidelines Implementation

Instructional Guidelines Outlines:

- Introduction
- Aim
- Components
- Summary

The instructional guidelines consisted of 4 sessions. carried out in 2 weeks (4 sessions/ week) for every nurse, researcher met nurses weekly on Saturday, Monday, Tuesday and Thursday in morning and/or after noon shift Implementation of instructional guidelines took about 3 months, as it started from beginning of march 2018 to end of May 2018. The instructional guidelines carried out as the following:

The first session (60 Minutes): The aim of this session was to identify the researcher with the study sample (nurses) and explain to them the purpose of instructional guidelines. Number of sessions, duration of each session, content outlines of numeric values are assigned to the levels of response instructional guidelines sessions, methods of teaching, time of the

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study and methods of evaluation were discussed to stimulate the nurses' interest and to enhance their appreciation for their role. Pretests assessment was carried out at this session, researcher assessed nurses' knowledge about hyperbilirubinemia and BIND tool by using nurses' knowledge questionnaire and assessed skills of each nurse in application of BIND tool by using an observational checklist on BIND tool. Each session was preceded by open discussion about any question and brief summary about what being discussed in the previous session. Researcher used handouts and illustrated pictures.

The Second Session: (60 Minutes): The aim of this session was to inform the nurses with definition of, causes and management of hyperbilirubinemia, BIND tool and demonstrate to nurses how to apply BIND tool actually upon neonates and allow them to re-demonstrate application of BIND tool upon neonates.

The Third Session: (60 Minutes): The aims of this session were to carry out posttest and post instructional guidelines skill assessments.

The Fourth Session: (60 Minutes): Aimed summarizing all the information and techniques taught, Satisfactory skills. Answer all nurses' questions and clarify any misunderstanding.

II. Operational Design:**Preparatory phase**

Preparation of the study tools was based on reviewing of the past and current, local and international available literature using books, articles, periodicals magazines and internet. This was necessary for the researcher to be acquainted with, and oriented toward all aspects of the research problems and to develop the study tools for data collection.

Content validity & Reliability:

Tools will be reviewed by 5 expertises in the field of pediatric nursing and medicine to ascertain relevance and completeness of the study. Cronbach's Alpha of knowledge about hyperbilirubinemia was very good as it was. 956. Cronbach's Alpha of an Arabic observational checklist on BIND was good and it was.841.

Ethical consideration:

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

- Informed consent was obtained from participant after explaining the purposes of the study.
- No harm occurred to participant.
- Each participant had right to withdraw from the study at any time.
- Data was confidential and used by researcher only.

Pilot study:

Pilot study was conducted on (5) nurses and 10 neonates were chosen randomly as representing 10% of the total sample from different hospital based on sample criteria. These nurses were excluded from the total sample of the study. It was conducted to evaluate the content and face validity of the tools to find the possible obstacles and problems that might be faced during data collection. Then according to the necessary modification of data collection plan and tools were done "some questions were modified "reversed" and others cancelled".

Field work:

The actual fieldwork carried out for data collection started in the beginning of March 2018 and lasted until the end of May 2018. Data collected four days per week during the morning and afternoon shifts (Saturday, Monday, Tuesday and Thursday), to provide instructional guideline, nurses were divided into nine groups. Each group contained five to six nurses. Each nurse received four sessions. Each session lasted for an hour. The researcher conducted group discussion and distributed an explanatory related booklet. Sessions were conducted in NICUs in previously mentioned settings.

The researcher was visiting the two NICUs time stay in each unit was 3hour per day. The researcher was observing 5-6 nurses per day divided them to two groups during performances' care for neonates The researcher introduced herself to the nurses who will share in the study, explained the purpose of study and methods of data collection. After that

researcher assessed nurses' knowledge about hyperbilirubinemia and BIND score by using nurses' knowledge questionnaire, this took about 20-30 minutes for each nurse (pretest in the first session of instructional guidelines). In the same day of first session the researcher started to ask each nurse to assess BIND score her assigned neonates in NICU, during performing this assessment researcher assessed skills of each nurse in application of BIND score by using the observational checklist about BIND score, this was considered pre instructional guidelines carried out by nurses and was being compared with what measured by researcher upon the same neonates, this took about 20-30 minutes for each nurse.

In the next day (second session) researcher provided knowledge about hyperbilirubinemia and BIND score and demonstrated to nurses actually upon neonates with hyperbilirubinemia how to apply BIND score, this took about 60 minutes and allow to each nurse to re-demonstrate it. After one week from pretest, researcher carried out posttest (third session) to reassess nurses' knowledge by using the same tool in pretest; this took about 20-30 minutes and researcher reassessed nurses skills of applying BIND score by using the observational checklist about BIND score actually upon neonates with hyperbilirubinemia, this was considered post instructional guidelines and was compared with what measured by researcher to the same neonates assigned for each nurse, this took about 15-20minutes.. Each session included 2-3 nurses or more according to availability of their time and duties.

In the next day (4th session) researcher summarized all the information and techniques taught, answered all nurses' questions and clarified any misunderstanding and thanked nurses. The researcher collected the socio demographic data about children from medical record and this took about 5-10 minutes for each neonates. The instructional guidelines were performed in (3) phases:

Assessment phase: Assessing nurses' performance for neonates having hyperbilirubinemia ('pretest'); this phase started with the nurses' interview and the researcher introduced herself to nurses. At the beginning of the instructional guidelines; an orientation and explanation to the instructional guidelines of early detection of neurological dysfunction among neonates having hyperbilirubinemia were done for nurses, and the aim and objective of the study were explained to gain their cooperation. They were assured about the anonymity of their answers and that the information given will be used for scientific research only and be treated with strict confidentiality.

Implementation phase: The implementation of the instructional guidelines sessions aimed to enhance the performance of nurses caring for neonates having hyperbilirubinemia. The instructional guidelines intervention consumed 12 weeks (4 days per week) spent in conducting the training instructional guidelines. Consequently, the subjects' content has been sequenced through 4 sessions. The duration of each session took about 60 minutes including periods of discussion. At the beginning of first session, an introduction about the instructional guidelines was done. Each session started with the summary feedback about the previous session, simple words and Arabic language were used to suit the nurses' level of understanding. Different methods of teaching were used as lectures and demonstration. Suitable teaching aids were prepared and used during the guidelines' implementation such as; posters and pictures. The previous questionnaire formats and observational checklists.

Evaluation phase: Guidelines appraisal was done by comparing the nurses 'knowledge and practices through pre and posttests of the instructional guidelines using the same questionnaire formats sheet and observation checklists.

Administrative design:

An official written approval letter clarifying the purpose of the study was obtained from the Dean of Faculty of Nursing, Ain Shams University to collect data from the pre mentioned study settings, also written approval was submitted to the director of Benha University Hospitals and director of Specialized Children Hospital to collect data from pre mentioned study setting.

Statistical design:

After completion of data collection, the data were entered and tabulated, statistically analyzed using Data entry was done using Epi-Info 6.04 computer software package, while statistical analysis was done using statistical software package SPSS 15.0. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables.

Statistical methods:-*The following tests were done:*

- **Independent-samples t-test** of significance was used when comparing between two means.
- **Paired sample t-test** of significance was used when comparing between related sample.
- **Chi-square (χ^2)** test of significance was used in order to compare proportions between two qualitative parameters.
- **Spearman's rank correlation coefficient (rs)** was used to assess the degree of association between two sets of variables if one or both of them was skewed.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:
 - Probability (P-value)
 - P-value ≤ 0.05 was considered significant.
 - P-value ≤ 0.001 was considered as highly significant.
 - P-value > 0.05 was considered insignificant.

III. STATISTICAL RESULTS

TABLE 1: shows that, more than one third of studied nurses (36%) were in age group of 25-30 years. Regarding nurses' qualifications, more than half of studied nurses (60%) had nursing diploma. In relation to years of experience, approximately one third of studied nurses (32%) had < 5 years of experience. Regarding training courses, the majority of studied nurses (96%) did not attend any previous training courses.

TABLE 2: shows that, more than half of studied neonates were males (68%). However, for (62%), neonates was preterm for Gestational age. And according to type of feeding, (72%) of studied neonates had artificial feeding more than half (60%) of studied neonates were delivered by cesarean section, while the rest of them (40%) were delivered by normal vaginal delivery.

TABLE 3: shows a highly statistical significant difference between total score level of nurse's knowledge pre and post regarding to knowledge about bilirubin induced neurological dysfunction of newborns with Hyperbilirubinemia, $\chi^2=19.369$, with p-value <0.001.

TABLE 4: shows a highly statistical significant difference between total score level of nurse's knowledge pre and post regarding to knowledge of nurses working in neonatal care units about BIND tool for early detection of neonatal dysfunction with hyperbilirubinemia, $\chi^2= 37.831$, with p-value <0.001.

TABLE 5: shows a highly statistical significant difference between total score level of nurse's knowledge pre and post regarding knowledge nurse's knowledge on ways to infection in neonatal with Hyperbilirubinemia, $\chi^2= 30.942$, with p-value <0.001.

TABLE 6: shows a highly statistical significant difference between total score level of nurse's total knowledge, $\chi^2=23.188$, with p-value <0.001.

TABLE 7: show that, more than two third of studied neonates (74%) had Low Risk. And the minority of studied neonates (6 %) had severe risk about BIND tool this by the researcher and also shows that more than two half of studied neonates (62%) had Low Risk. And the studied neonates (20%) had severe risk about BIND tool by the nurses.

TABLE 8: shows that there was statistical significant difference between total BIND tool of nurses and researcher regarding total level of practice in pretest $\chi^2= 8.384$, p-value <0.0.

TABLE 9: shows that there was statistical significant difference between mean BIND tool of nurses and researcher regarding mental status, muscle tone and cry pattern and mean total score of practice in pre-test $t=4.387$, $p < 0.001$, $t=3.810$, $p 0.002$, $t=2.224$, $p 0.028$, $t=3.702$, $p < 0.001$ respectively.

TABLE 10: shows the relation between nurses' demographic characteristics and satisfied regarding knowledge score. The result found that there were statistically significant relation between knowledge and their years of experience and educational level with p-value (<0.05).

TABLE 11: reveals that there is a highly statistically significant correlation between total practice in post and total knowledge in post, with p-value (<0.001).

TABLE 12: reveals that there is a statistically significant correlation between total practice and total knowledge in post according to their years of experience and educational level, with p-value (<0.05).

FIGURE I: shows a highly statistical significant difference between total score level of nurse's knowledge pre and post regarding to knowledge about hyperbilirubinemia, before implementation of guidelines and after $\chi^2=16.066$, with p-value <0.001.

FIGURE II: shows that there was statistical significant difference between mean BIND tool of nurses and researcher regarding mental status, muscle tone and cry pattern and mean total score of practice in pre-test $t=4.387$, $p < 0.001$, $t=3.810$, $p 0.002$, $t=2.224$, $p 0.028$, $t=3.702$, $p < 0.001$ respectively.

FIGURE III: shows that there was statistical significant difference between compatibility between nurse and researcher of pre and post regarding total practice, $\chi^2= 13.113$, p-value <0.001

Table (1): Number and percentage distribution of the studied nurses according to their characteristics (N=50).

Socio-Demographic data	No.	%
Age in year		
20 <25	13	26
25 <30	18	36
30 <35	9	18
≥35	10	20
Mean±SD	29.23±4.29	
Years of experience		
<5	16	32
5<10	14	28
10 <15	12	24
≥15	8	16
Mean±SD	7.88±2.68	
Educational level		
Nursing diplomas	30	60
Technical nursing education	10	20
Bachelor degree of nursing	9	18
Postgraduate nursing study	1	2
Work place		
Benha University Hospitals	24	48
Children's Hospital in Benha	26	52
Attended training programs		
No	42	96
Yes	2	4

Table (2): Number and percentage distribution of the studied neonates according to their characteristics (N=100).

Characteristics of the newborn	No.	%
Sex		
Male	68	68
Female	32	32
Gestational age of the child		
Pre term	62	62
Full-term	31	31
Post term	7	7
Age days		
≤3 days	38	38
>3-6 days	37	37
>6-9 days	19	19
>9 days	6	6
Mean±SD	4.81±2.52	
Birth Type		
Normal delivery	40	40
Cesarean section	60	60
Feeding Type		
Artificial feeding	72	72
Artificial feeding & Breast feeding	28	28

Table (3): Number and percentage distribution of the studied nurses regarding to knowledge about bilirubin induced neurological dysfunction of newborns with Hyperbilirubinemia pre and post implementation of guidelines (N=50).

Knowledge about Bilirubin- induced neurological dysfunction of newborns with Hyperbilirubinemia	Pre		Post		Chi-square test	
	No.	%	No.	%	x ²	p-value
Definition						
Satisfied	13	26.0	36	72.0	21.168	<0.001**
Unsatisfied	37	74.0	14	28.0		
Causes						
Satisfied	13	26.0	39	78.0	27.083	<0.001**
Unsatisfied	37	74.0%	11	22.0		
Method to assess the Bilirubin-induced neurological dysfunction.						
Satisfied	14	28.0	41	82.0	29.455	<0.001**
Unsatisfied	36	72.0	9	18.0		
High risk neonatal to Bilirubin-induced neurological dysfunction						
Satisfied	14	28.0	33	66.0	14.492	<0.001**
Unsatisfied	36	72.0	17	34.0		
Early symptoms of Bilirubin- induced						

Knowledge about Bilirubin- induced neurological dysfunction of newborns with Hyperbilirubinemia	Pre		Post		Chi-square test	
	No.	%	No.	%	x2	p-value
neurological dysfunction						
Satisfied	9	18.0	34	68.0	25.500	<0.001**
Unsatisfied	41	82.0	16	32.0		
Method to treatment						
Satisfied	13	26.0	38	76.0	25.010	<0.001**
Unsatisfied	37	74.0	12	24.0		
Complications						
Satisfied	13	26.0	30	60.0	11.791	<0.001**
Unsatisfied	37	74.0	20	40.0		
Total						
Satisfied	13	26.0	36	72.0	19.369	<0.001**
Unsatisfied	37	74.0	14	28.0		

**p-value <0.001 HS

Table (4): Number and Percentage distribution of the studied nurses regarding to knowledge about BIND tool pre and post implementation of guidelines (N=50).

Knowledge regarding BIND tool	Pre		Post		Chi-square test	
	No.	%	No.	%	x2	p-value
Definition						
Satisfied	4	8.0	39	78.0	49.980	<0.001**
Unsatisfied	46	92.0	11	22.0		
Importance of the BIND tool.						
Satisfied	4	8.0	36	72.0	42.667	<0.001**
Unsatisfied	46	92.0	14	28.0		
BIND tool components include:						
Satisfied	5	10.0	34	68.0	35.351	<0.001**
Unsatisfied	45	90.0	16	32.0		
The importance of using the BIND tool						
Satisfied	4	8.0	34	68.0	38.200	<0.001**
Unsatisfied	46	92.0	16	32.0		
Parameters are used in the BIND tool						
Satisfied	2	4.0	33	66.0	42.242	<0.001**
Unsatisfied	48	96.0	17	34.0		
Total scores of the BIND tool						
Satisfied	6	12.0	36	72.0	36.946	<0.001**
Unsatisfied	44	88.0	14	28.0		
BIND items						

Knowledge regarding BIND tool	Pre		Post		Chi-square test	
	No.	%	No.	%	x2	p-value
Satisfied	5	10.0	34	68.0	35.351	<0.001**
Unsatisfied	45	90.0	16	32.0		
The degrees of the tool BIND						
Satisfied	4	8.0	36	72.0	42.667	<0.001**
Unsatisfied	46	92.0	14	28.0		
Total						
Satisfied	4	8.0	35	70.0	37.831	<0.001**
Unsatisfied	46	92.0	15	30.0		

**p-value <0.001 HS

Table (5): Number and Percentage distribution of the studied nurses according to their knowledge nurse’s knowledge about infection in neonatal with Hyperbilirubinemia pre and post implementation of guidelines (N=50).

Knowledge	Pre		Post		Chi-square test	
	No.	%	No.	%	x2	p-value
hand washing						
Satisfied	20	40.0	50	100.0	42.857	<0.001**
Unsatisfied	30	60.0	0	0.0%		
Hands are washed between one newborn and another						
Satisfied	20	40.0	40	80.0	16.667	<0.001**
Unsatisfied	30	60.0	10	20.0		
Sterilizations the incubator for the newborn with jaundice						
Satisfied	14	28.0	46	92.0	42.667	<0.001**
Unsatisfied	36	72.0	4	8.0		
The incubator is cleaned with a substance						
Satisfied	20	40.0	45	90.0	27.473	<0.001**
Unsatisfied	30	60.0	5	10.0		
Factors that help spread the infection in neonatal unit						
Satisfied	15	30.0	41	82.0	27.435	<0.001**
Unsatisfied	35	70.0	9	18.0		
symptoms of neonatal infection						
Satisfied	15	30.0	45	90.0	37.500	<0.001**
Unsatisfied	35	70.0	5	10.0		
Total						
Satisfied	17	34.0	45	90.0	30.942	<0.001**
Unsatisfied	33	66.0	5	10.0		

**p-value <0.001 HS

Table (6): Number and Percentage distribution of the studied nurses and researcher according to their practice of BIND tool pre and post implementation of guidelines (N=50).

Practice of BIND score sheet	Pre		Post	
	No.	%	No.	%
Mental status: Nurses				
Normal	5	10.0	26	52.0
Sleepy, poor feeding	26	52.0	21	42.0
Lethargic, irritable	15	30.0	3	6.0
Semi- Conscious, seizures, coma	4	8.0	0	0.0
Mental status: Researcher				
Normal	22	44.0	21	42.0
Sleepy, poor feeding	25	50.0	29	58.0
Lethargic, irritable	0	0.0	0	0.0
Semi- Conscious, seizures, coma	3	6.0	0	0.0
Muscle tone: Nurses				
Normal	9	18.0	22	44.0
Mild, hypertonia or hypotonia	25	50.0	25	50.0
Mild truncal arching	6	12.0	0	0.0
Opisthotonos, bicycling movements	10	20.0	3	6.0
Muscle tone: Researcher				
Normal	26	52.0	15	30.0
Mild, hypertonia or hypotonia	15	30.0	32	64.0
Mild truncal arching	9	18.0	3	6.0
Opisthotonos, bicycling movements	0	0.0	0	0.0
Cry pattern: Nurses				
Normal	9	18.0	26	52.0
High pitched	22	44.0	15	30.0
Shrill	16	32.0	9	18.0
Inconsolable	3	6.0	0	0.0
Cry pattern: Researcher				
Normal	4	8.0	21	42.0
High pitched	39	78.0	23	46.0
Shrill	7	14.0	6	12.0
Inconsolable	0	0.0	0	0.0
Total Score Nurses				
Low Risk	31	62.0	41	82.0
Moderate Risk	9	18.0	6	12.0
Severe Risk	10	20.0	3	6.0
Total Score Researcher				
Low Risk	37	74.0	41	82.0
Moderate Risk	10	20.0	9	18.0
Severe Risk	3	6.0	0	0.0

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Table (7): Number and Percentage distribution of the studied nurses according to their total knowledge pre and post implementation of guidelines (N=50).

Total Knowledge	Pre knowledge		Post knowledge		Chi-square test	
	No.	%	No.	%	x2	p-value
Satisfied	11	22.0	35	70.0	23.188	<0.001**
Unsatisfied	39	78.0	15	30.0		
Total	50	100.0	50	100.0		

**p-value <0.001 HS

Table (8): Correlation between studied nurse's practices and their knowledge.

Total knowledge	Mean Score of practice			
	Pre		Post	
	R	p-value	r	p-value
Pre	0.255	0.303		
Post			0.463	<0.001**

P-value >0.05 NS; **p-value <0.001 HS

Table (9): Correlation between studied nurse's practices and knowledge according to their demographic data.

		Mean score of knowledge	Mean Score of practice
Age in year	r	-0.037	-0.090
	p-value	0.801	0.534
Years of experience	R	0.468	0.292
	p-value	<0.001**	0.018*
Educational level	R	0.371	0.283
	p-value	0.024*	0.021*

P-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

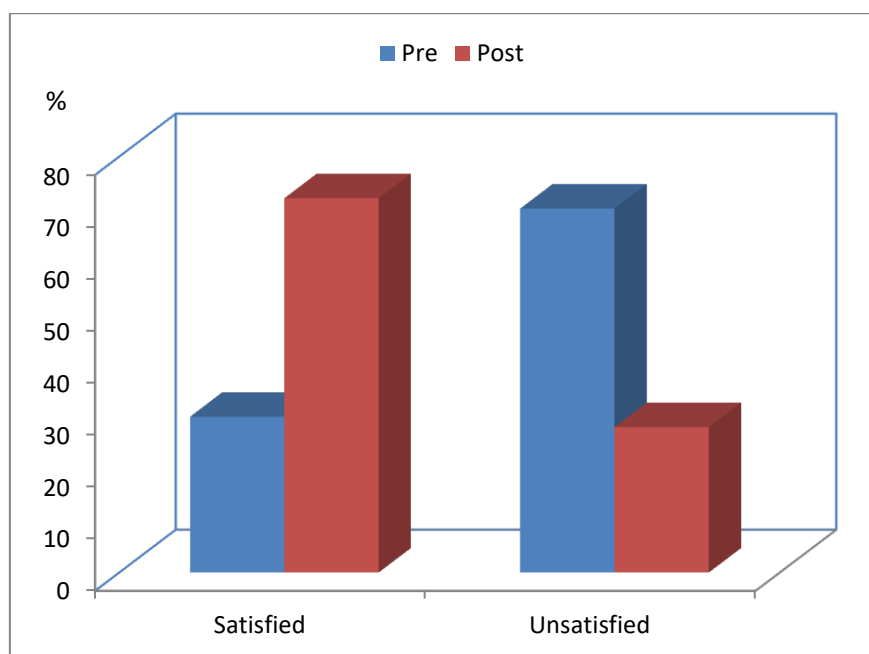


Figure (1): Percentage of studied nurses regarding to knowledge about neonatal hyper-bilirubinemia the pre and post guidelines (N=50).

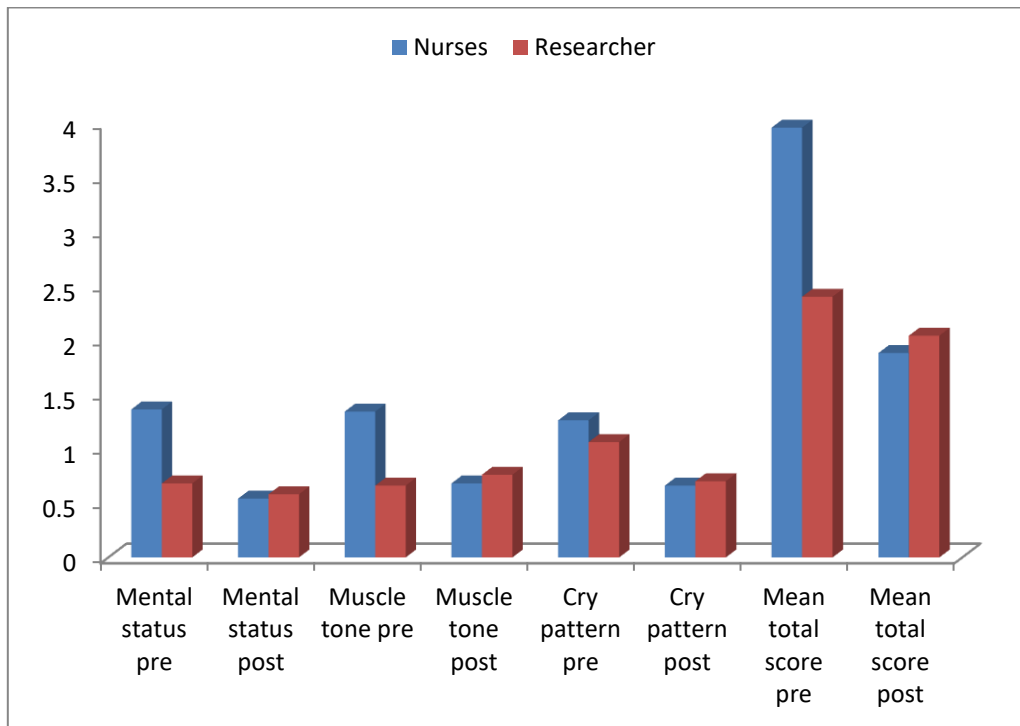


Figure (2): Mean and standard deviation of nurses and researcher according to their mental status, muscle tone and cry pattern of practice pre and post implementation of guidelines (N=50).

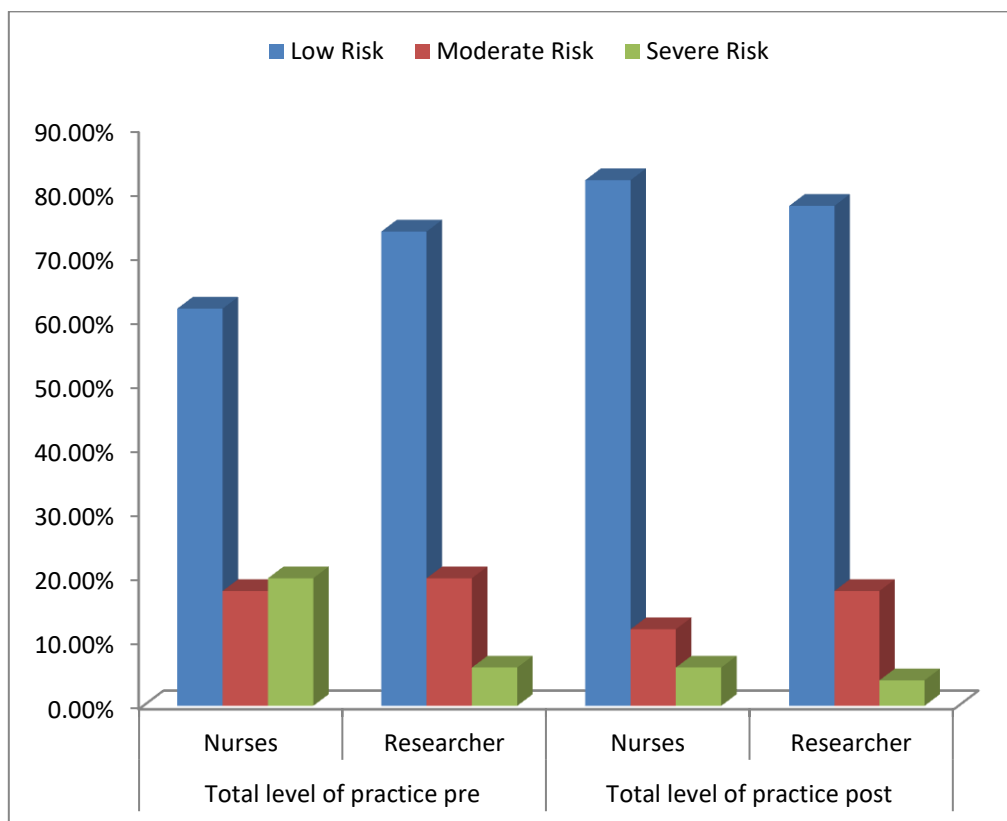


Figure (3): Percentage of nurses and researcher according to their total level of practice pre and post implementation of guidelines (N=50).

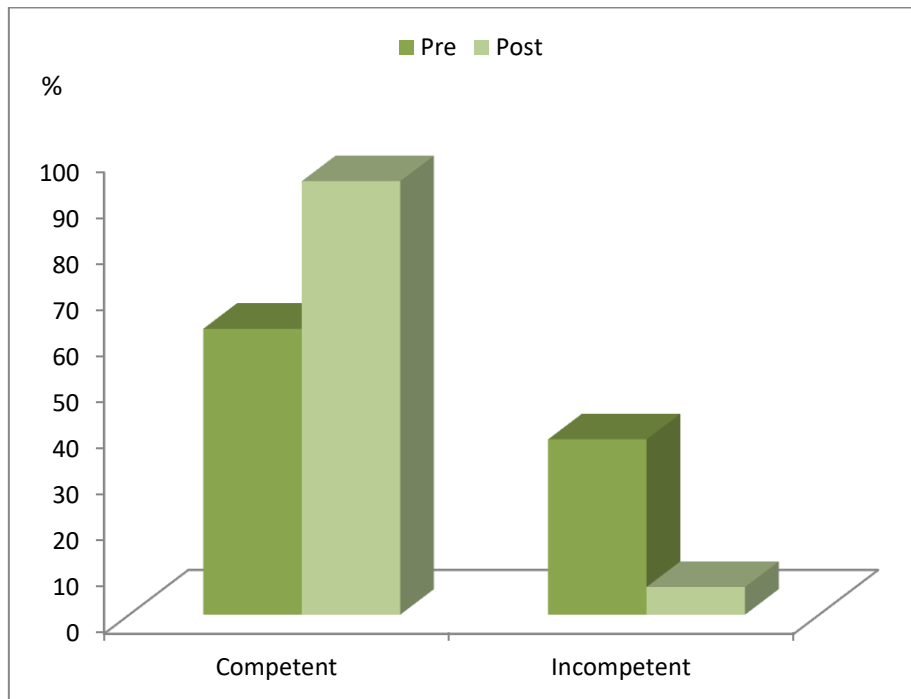


Figure (4): Percentage of nurses according to their compatibility between nurses and researcher related total practice pre and post implementation of guidelines (N=50).

IV. DISCUSSION

Neonatal jaundice is the most common health hazard of neonates. It is caused by hyperbilirubinemia that appears in almost 60% of the term neonates and approximately in more than 80% of the premature neonates in the first three days after birth (Henny-Harry, & Trotman, 2012; National Collaborating Centre for Women’s and Children’s Health, 2010).

Severe hyperbilirubinemia and kernicterus still occur with high frequency in many Middle East and developing nations (Wennberg, Alfors & Aravkin, 2009). An accurate and reliable scoring system is needed to characterize the phases and progression at: ABE and to determine prognosis The BIND score provides a schema for grading the severity of ABE that has also been used as a clinical tool in a retrospective study and may help nurses understand the progression of bilirubin induced neurological dysfunction (Volpe, 2001).

Although neonatal care has improved in Egypt, severe neonatal hyperbilirubinemia is still a raging problem, many cases are being missed and the incidence of bilirubin induced neurological dysfunction is still high (Seoud et al., 2007).

In Egypt, the incidence in the general population has not been documented but according to reports from different places in the world, Kernicterus cases have continued to occur and are even increasing (Kahlan, & Hammerman, 2004; and Manning, 2005).

The most appropriate nursing intervention for neonates with hyperbilirubinemia is to monitor bilirubin level, identify infants at risk for developing severe form of hyper-bilirubinemia and implement prescribed treatment effectively when indicated (Watson, 2012).

The current study hypothesized that instructional guidelines will enhance neonatal nurses’ performance regarding early detection of neurological dysfunction among neonates having hyperbilirubinemia. Posttest than on pretest

Regarding characteristics of studied nurses the present study illustrated that more than one third of studied nurses were in age group 25-30 years. This finding was consistent with Ashor et al., (2017) who conducted a research about “Effect of a Designed Nursing Care Protocol on Clinical Outcomes of Neonates with Hyperbilirubinemia” who found that more than one thirds of studied nurses aged 25-30 years. This reflects that more than one third of nurses had few years of experience in NICU.

Also, this showed that more than half of nurses were diploma nurses. This finding was in line with *El-Shahat, (2014)* who conducted a research about "Assessment of nurses' knowledge and practice about care needed for newborn under phototherapy in neonatal intensive care unit in Ismailia city" who found that less than half of studied nurses had nursing diploma. Meanwhile, such finding was inconsistent with *Mohamed, (2015)* who reported that three fifths of studied neonates had secondary school of nursing diploma. The National Association of Neonatal Nurses (*NANN*) (*2005*) recommended that nurses who work in NICUs must be graduates from baccalaureate degree programs to be prepared as highly qualified nurses and to be more mature in age.

Regarding years of experience, the current study showed that approximately one third of studied nurses had <5 years of experience in NICU. This finding was in agreement with *Mohamed, (2010)* found that the highest percentages of studied nurses had 1<10 years of experience. "*NANN*" (*2008*) recommended that, nurses who work in NICU must receive professional training to become qualified neonatal nursing practitioners. Also, they need life- long training to be able to identify new trends in neonatal nursing. In USA, The neonatal nurse practitioner must have two years' experience in caring for neonates in order to be practitioners in NICU. It is assumed that years of experience have a significant positive effect on the nurses' knowledge and performance which result in improving quality of care provided.

The findings of the current study revealed that the majority of studied nurses did not attend any previous training courses. This finding may be due to the shortage of nurses' number, absence of continuing education department in the hospital, lack of motivation for training as well as increased work load in Neonatal Intensive Care Units. These findings were in the same line with a study done by *El-Shahat, (2015)* who was found that majority of nurses did not attend any training sessions related to neonatal jaundice.

As well, these findings were in agreement with *El Sayed, (2007)* who was found that the majority of studied nurses did not receive previous training courses. This may be one of the leading causes for lack of knowledge and skills among nurses caring for neonates having hyperbilirubinemia. So, neonatal nurses were in need for training to improve the quality of care. Additionally, *Carol, (2009)* mentioned that formal training courses play an important role in enhancing and updating nurses' knowledge, performance and improving the quality of care given to neonates.

Regarding characteristics of studied neonates, the present study illustrated that more than half of studied neonates were males. It was clearly stated by several authors that male infants were at higher risk for developing severe jaundice than female infants (*Zoubir et al., 2011*). This finding was consistent with a study done by *El Mazzahy, (2013)* found that the ratio of attending males to females was 1.4 to 1. Also, these results were in agreement with *Sabry (2014)* in his study "The nurse's role in the prevention of acute bilirubin toxicity among neonates undergoing exchange transfusion". who reported that the incidence of hyper-bilirubinemia was higher among males than females.

Regarding type of feeding, the current study represented that the majority of studied neonates had artificial feeding. This finding was consistent with *El-Sayed et al., (2013)* who conducted a research about "Effect of phototherapy on behavior of jaundiced neonates" and revealed that the majority of studied neonates were fed by bottle.

For gestational age of studied neonates, the present study revealed that more than half of studied neonates wear preterm (Table2) This finding was in line with *Mohamed, (2008)* who reported that the age of the neonates ranged from day 10 with a mean age 4.5 ± 2 days. Also, these results came in agreement with *Sabry, (2013)* who revealed that mean age on admission was 4.56 ± 1.59 .

In the current study, more than half of the neonates were delivered cesarean section (CS) and less than third were delivered by normal delivery. This finding was disagree with study carried out by *Seoud et al. (2007)*, who reported that majority were delivered vaginally and minority were delivered by CS. Some studies postulated that the higher risk of neonatal jaundice with CS delivery may be attributed to the effect of drugs or anesthetics given to the mother, while others suggested that infusions with concentrated dextrose water to mothers prior to cesarean delivery increased the risk of hypoglycemia in the newborn, and were associated with increased incidence of neonatal jaundice.

The results of the current study illustrated that there was a highly statistical significant difference between total score level of nurse's knowledge about hyperbilirubinemia pre and post application of instructional guideline. This result was consistent with *Mohamed, (2015)* who conducted study about "Effect of clinical pathway on care of neonates having hyper-bilirubinemia" found that there were statistical significant differences between study and control groups regarding hyperbilirubinemia. The current results were attributed to increased knowledge of nurses as well as their adherence to the practical guidelines of the designed instructional guidelines for neonates with hyperbilirubinemia.

Regarding of nurses' knowledge about bilirubin induced neurological dysfunction of newborns with Hyperbilirubinemia illustrated that a highly statistical significant difference between total score level of nurse's knowledge pre and post instructional guidelines about bilirubin induced neurological dysfunction of newborns with Hyperbilirubinemia. This finding came in agreement with *WHO, (2006)*. They stated that there was inadequate nurses' knowledge and performance and attributed this deficiency to one or more of the following reasons lack of orientation program prior to work, lack of nursing care conference during work and lack of supervision. The National Association of Neonatal Nurses (*NANN (2008)*) identified that neonatal nurses must be proactive in the assessment and management of hyper-bilirubinemia in the newborn. They added that neonatal nurses must take steps to increase awareness and identify strategies within their institutions and practice to enhance the processes of diagnosis and management of hyper-bilirubinemia.

The results of the current study presented that nurses' knowledge about BIND tool in pretest was unsatisfactory but their knowledge was improved after provision of instructional guidelines in posttest and there was a statistically significant difference between mean scores of nurses' knowledge in pretest and posttest. The result of current study is in agree with what was reported by *Shrestha, (2013)* who conducted a research about "Knowledge and practices of nursing personnel regarding the care of neonates under phototherapy" as the findings of their studies revealed that during pretest, the majority of the staff nurses had average knowledge regarding the neurological assessment of neonates and minority of them had poor knowledge. After the administration of self-instructional module in posttest the majority of the staff nurses had good knowledge and minority of them had average knowledge unsatisfactory nurses' knowledge about BIND tool.

From point of view of researcher may be return to that the majority of nurses their level of education only diploma in addition and though, the students are exposed to neonatal critical care nursing in their studying curriculum, but they are not prepared or knowledgeable enough to provide care for neonates in NICUs. Besides that lack of training educational programs for staff nurses about appropriate care for NICUs patients in general and BIND tool specifically, its benefits and applicability and also reflects the lack of responsibility of nursing director and management staff in providing such training programs for staff nurses in NICUs.

Regarding nurses' knowledge about nursing care of neonates with hyperbilirubinemia about infection control on pre intervention and after. The present study showed that there was a highly statistical significant difference between total score level of nurse's knowledge pre and post regarding nurse's knowledge to infection in neonatal with hyperbilirubinemia. These results agreed with *Abo-Zaid, (2008)* who conducted a research about "Quality of nursing care for high risk neonates receiving total parental nutrition". They found that the majority of nurses had incompetent level of hand washing performance. This might be due to hand washing was not followed routinely by the majority of nursing procedures due to insufficient or lack of training and knowledge about measures of infection control at NICU and improper application of infection control standards at NICU. This could reflect the importance of conducting a training program for nurses regarding infection control.

Regarding mean scores of nurses' total knowledge about nursing care of neonates with hyperbilirubinemia illustrated that there was highly statistical significant difference between total score level of nurse's knowledge pre and post regarding knowledge. This was attributed to the effect of training and instructions that were provided by the researcher. This was in line with *Devi & Jena, (2015)* who conducted research about "Effectiveness of Video Assisted Teaching Module (VATM) on Knowledge Regarding Care of Newborn Baby under Phototherapy among Female Health Workers". They observed that the overall mean score during posttest was revealed the effectiveness of the module.

The current study reported that majority of cases of newborns with mild BIND tool had abnormal neurological examination (subtle neurological examination). Ten of cases of newborns with moderate BIND tool had abnormal neurological examination and another one progressed to death. Three case with severe BIND tool. This finding agreed with *Ragab, (2012)* who conducted a study about "The effect of applying BIND tool on the early detection of neurological signs among neonates with hyperbilirubinemia under phototherapy at neonatal intensive care unit. Who proved that three cases out of 12 newborns with normal BIND tool had pre-discharge abnormal neurological examination. As well, 3 cases out of 28 newborns with mild BIND score had pre discharge abnormal neurological examination, and 8 cases had subtle neurological examination. One case of the nine newborns with moderate BIND tool had abnormal neurological examination and another one progressed to death.

The results of the current study presented that total nurses' practices about BIND tool on pre intervention and after. The results illustrated that there was statistical significant difference between total BIND tool of nurses and researcher regarding total level of practice in pretest. This could be due to the implementation of Instructional guidelines to enhance neonatal nurses' performance regarding early detection of neurological dysfunction among neonates having hyperbilirubinemia.

The results of present study indicated that there was a statistically significant difference between mean scores of BIND tool measured by nurses and mean BIND score measured by researcher before providing instructional guidelines assessment, but there were no statistically significant differences between mean BIND tool measured by nurses and what measured by researcher in both post instructional guidelines. From point of view of researcher this reflects the success of instructional guidelines in enhancing skills of nurses in application of BIND tool and also reflects the extent of readiness of nurses to gain knowledge and skills to improve their skills in NICUs.

The results of present study revealed that there was a statistically significant relation between nurses' demographic characteristics and knowledge score. The result found that there were statistically significant relation between knowledge and their years of experience and educational. The results of the current study are in accordance with what was found by *Shrestha, (2013)* who found in their studies that there was a positive relationship between nurses' knowledge scores and nurses' demographic in NICUs.

From point of view of researcher this indicates to the connection between well comprehended information and its application clinically as if nurses have knowledge and this knowledge well understood nurses are being able to apply it as possible and vice versa

The results of the current study concerning correlation between total knowledge and total practices. The present study reflected that there were highly statistical significant positive correlations between total knowledge and total practices. This finding agreed with *Abd-El Galil, (2007)* who proved that, there were a statistical significant correlation between nurses' knowledge and their performance. On the contrary, *Fathy, (2004)* who conducted study about "Intervention nursing program for care of high risk neonates at Mansoura Hospitals" and found that there was no statistically significant differences between nurses' knowledge and performance.

For correlation between nurses' practices and, correlation between total nurse's practices and knowledge according to their demographic data. It was found that there is a statistically significant correlation between total practice and total knowledge in post according to their years of experience and educational level. This could be attributed to nurse's adherence to guidelines related to early detection of neurological dysfunction among neonates having hyperbilirubinemia regarding to increasing nurses.

Finally, instructional guidelines enhancement neonatal nurses' performance regarding early detection of neurological dysfunction among neonates having hyperbilirubinemia. Regarding to increasing nurses' knowledge in posttest, This proved the positive effect of instructional guidelines upon nurses as increased their knowledge and achieved aim of current study.

V. CONCLUSION

Based on the results of the current study and answer research hypothesis it could be concluded that: Most of NICUs nurses' have unsatisfactory knowledge and skills before application of instructional guidelines, but most of NICUs nurses became having satisfactory knowledge and skills after the application of instructional guidelines. Also, there were statistically significant differences between mean scores of pretest and posttest regarding nurses' knowledge and there were statistically differences between mean scores of skills before and after application instructional guidelines upon neonates having hyper-bilirubinemia.

VI. RECOMMENDATIONS

From this study we can recommended that:

- Provision of periodic workshops and seminars for NICUs nurses about assessment of hyperbilirubinemia and application of BIND tool.

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- Ongoing in-service education programs should be designed and implemented at neonatal intensive care units to improve nurses' knowledge and practices on the basis of nurse's actual needs.
- Future studies should be applied on a larger sample to investigate the effect of designed instructional guidelines nursing care neonates with hyper-bilirubinemia and early detection of neurological dysfunction among neonates having hyper-bilirubinemia to ensure the generalizability of results.

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