ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 7, Month: September 2024, Available at: https://hijnrp.journals.ekb.eg/

# Nurses' Compliance Regarding the Application of Neonatal Care Protocol on Mechanical Ventilation in the Intensive Care Unit

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## Abstract

**Background:** Neonatal care protocols are standardized guidelines that outline the best nursing practices for managing and treating ventilated neonates. These protocols cover various aspects of care, including respiratory management, nutritional support, medication administration, and developmental care. **Aim:** to assess nurses' compliance regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit. **Methods:** A descriptive design was utilized to conduct this study. **Setting:** This study was conducted in the Neonatal Intensive Care Unit at El Sheikh Zayed Al Nahyan Hospital affiliated to Specialized Amana Medical Centers in Egypt. **Sample:** A purposive sample composed of 68 nurses. **Tools:** The data collection tools were consisted of two tools as following: An interviewing Nurses' Questionnaire and Observational Checklists to assess nurses' knowledge and practices regarding the application of neonatal care protocol on mechanical ventilation. **Results**: It revealed that 54% of the studied nurses had an average level of knowledge, and 68% of the studied nurses demonstrated an incompetent level of practices regarding the application of neonatal care protocol on mechanical ventilation. **Conclusion:** More than half of the studied nurses had an average level of knowledge, and more than two-thirds of the studied nurses demonstrated an incompetent level of practices regarding the application of neonatal care protocol on mechanical ventilation. In addition, there is a highly statistically significant relation between years of experience in the NICU and their knowledge levels. Moreover, there is no significant relations between gender, previous training and nurses' practice levels. **Recommendations:** Developing a nursing protocols for mechanical ventilation, and conducting periodical educational training programs for nurses to update and enhance their knowledge and practices in caring for mechanically ventilated neonates.

**Keywords:** *Compliance, Intensive Care Unit. Knowledge, Mechanical Ventilation, Nurses, Practices*,

## Introduction

The neonatal period is the first 28 days of life after birth. It is a critical time for the newborn, as transitioning from the intrauterine environment to the outside world. During this period, the newborn is particularly vulnerable to a range of health issues, including infections, respiratory distress, and metabolic disorders **(Doherty et al., 2023).**

Neonatal care protocols are standardized guidelines that outline the best practices for managing and treating newborns in the NICU, regardless of where they are treated. These protocols are evidence-based and are developed to ensure consistency and quality of care across different healthcare providers and institutions. They cover a wide range of medical, nursing, and support services, including respiratory management, nutritional support, medication administration, and developmental care. Protocols also facilitate training and education of staff, ensuring that all team members are knowledgeable and competent in the latest neonatal care practices **(Lee et al., 2020).**

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Mechanical ventilation is a critical intervention for neonates who are unable to breathe adequately on their own. Indications for mechanical ventilation in neonates include severe respiratory distress syndrome, apnea of prematurity, congenital diaphragmatic hernia, and other conditions that compromise respiratory function. The primary goal is to maintain adequate oxygenation and ventilation while minimizing lung injury **(Yadav et al., 2023).**

Inadequate knowledge or poor practices can lead to errors, delays in treatment, and suboptimal care, all of which can negatively impact neonates' outcomes. Conversely, ongoing education and training for nurses ensure that they remain current with the latest protocol and best practices, which is essential for maintaining high standards of care. Studies have shown that targeted education programs and continuous professional development can significantly improve nurses' performance and, consequently, patient outcomes in the NICU **(Alsalem et al., 2023).**

Nurses in the NICU have a multifaceted role that encompasses direct patient care, monitoring, and support for the families of critically ill newborns. Their knowledge regarding neonatal care protocols is fundamental to providing consistent and effective care. This includes understanding the indications, procedures, and potential complications associated with various interventions, such as mechanical ventilation and nutritional support. In practice, nurses apply neonatal care protocols by performing clinical assessments, administering medications, adjusting ventilator settings, and implementing developmental care strategies **(Goodstein et al, 2021).**

**Significance of the Study**

Approximately 13.7% of all neonates admitted to NICUs worldwide required mechanical ventilation. Mortality rates for neonates on mechanical ventilation in NICUs worldwide vary widely depending on the underlying condition and severity of illness, but can be as high as 50% Neonates on mechanical ventilation in NICUs worldwide are at risk for a range of morbidities, including bronchopulmonary dysplasia, intraventricular hemorrhage, sepsis, and retinopathy of prematurity **(El-Masry et al., 2021).**

Mortality rates for neonates on mechanical ventilation in NICUs in the Middle East vary widely depending on the underlying condition and severity of illness, but can be as high as 50%. Neonates on mechanical ventilation in NICUs in the Middle East are at risk for a range of morbidities, including bronchopulmonary dysplasia, intraventricular hemorrhage, and sepsis **(Saber et al., 2023).** Mortality rates for neonates on mechanical ventilation in NICUs in the Arab region of Africa vary widely depending on the underlying condition and severity of illness, but can be as high as 30%. The morbidities, including respiratory distress syndrome, necrotizing enterocolitis, and sepsis **(Othman et al., 2020).**

The incidence of mechanical ventilation in neonates admitted to the NICU in Egypt was approximately 28%. Mortality rates for neonates on mechanical ventilation are vary widely depending on the underlying condition and severity of illness, but can be as high as 40%, there is a range of morbidities, including respiratory distress syndrome, sepsis, and bronchopulmonary dysplasia **(Owuor et al., 2023).**

This study is crucial due to the high vulnerability of neonates requiring respiratory support. Despite advancements, there remains a significant research gap in standardized practices and guidelines, leading to variability in care and outcomes. Addressing these gaps is essential to improving survival rates, minimizing complications, and ensuring optimal care for neonates in critical conditions within the NICU setting **(Ali et al., 2023).** So that, it is important to assess nurses' compliance regarding the application of neonatal care protocol on mechanical ventilation in the intensive care unit.

**Aim of the Study**

This study aimed to assess nurses' compliance regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit

**Research Questions**

The aim achieved through the following questions:

ISSN 2786-0183
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1) What are the level of nurses' knowledge regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit?
2) What are the level of nurses' practices regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit?
3) Level of nurses' knowledge practices and, the relation between them regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit?

**Operational Definition**

**Nurses compliance:**

Nurse compliance encompasses a broad range of knowledge and practices, ensuring that all nurses adhere to proper procedures and fully understand their responsibilities **(Ghabayen et al., 2023).**

**Neonatal Care Protocol:**

A set of rules and procedures for administering medical treatment, detailing the best practices for care, and providing a general statement of expectations to ensure high-quality care for newborns **(WHO and UNICEF, 2023).**

**Subject and Methods**

The subject and methods for this study were portrayed under the four main designs as follows:

**I) Technical design:**

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

***Research Design:***

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

***Research Setting:***

This study was conducted in the Neonatal Intensive Care Unit (NICU) at El Sheikh Zayed Al Nahyan Hospital, which is affiliated to Specialized Amana Medical Centers in Egypt. The NICU is located on the second floor and divided into two rooms. The first room contains six incubators, each one is equipped with oxygen ports and suction devices. The second room has seven incubators and one isolation incubator, all with their oxygen ports and suction devices. Each room has its own nursing station, and there is a storage room for devices, equipment, and supplies.

***Research Subject:***

**Sampling:**

A purposive sample consisting of 68 neonatal nurses working at neonatal intensive care unit at El Sheikh Zayed Al Nahyan Hospital. That were willing to participate in the study.

***Inclusion criteria:***

- Nurses working in the previous mentioned setting.
- Nurses age from 20 to 40 years.
- All levels of nursing qualifications.
- Both nurses gender.

***Exclusion criteria:***

- Nurse in internship period and orientation program

***Tools of Data Collection:*** The data collection tools were consisted of two tools as following:

**1st Tool: Nurses' Knowledge Questionnaire Sheet:**

ISSN 2786-0183
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It was designed by the researchers in simple Arabic language after reviewing current related literature. It comprised the following parts:

**Part (1): Characteristics of the studied nurses'** which include age, gender, qualifications, years of experience in the NICU, job title, and previous training about neonatal care protocol.

**Part (2): Characteristics of neonates undergoing mechanical ventilation:** This part used to assess neonates' gender, age, date of admission, neonates health problems, duration on mechanical ventilation in days, sedative drug used, level of consciousness and current ventilator mode.

**Part (3): Nurses' Knowledge Questionnaire Sheet:** This tool was adapted from **Mohamed, (2017)** and modified by the researcher to assess nurses' knowledge regarding application of neonatal care protocol on mechanical ventilator at neonatal intensive care units. This questionnaire was guided by policies, procedures and protocols of El Sheikh Zayed Al Nahyan Hospital. The questionnaire was in the form multiple choice and true or false answers.

This part included a series of questions to assess nurses' knowledge regarding the application of neonatal care protocol on mechanical ventilation in NICU. It was categorized under 8 main domain composed of (40) questions that addressed the overall level of the nurses' knowledge which divided into: Anatomy and physiology of respiratory system (5 questions), Parts and setting of mechanical ventilator (7 questions), Modes and alarms of mechanical ventilator (7 questions), Humidifier, oral care on mechanical ventilation (3 questions), Chest physiotherapy and suction care on mechanical ventilation (4 questions), Turning position and nutrition management of neonates on Mechanical Ventilation (4 questions), Criteria of placing neonates of MV and weaning (5 questions), Neonatal care protocol on mechanical ventilation (5 questions).

**Scoring system for knowledge:**

The nurses' responses were assessed as the following; one score was given for correct answer and zero for incorrect or did not answer. Total score for knowledge were (40 question with 40 grades). These scores were converted into a percent. The total level of nurses' knowledge was considered good knowledge if the percent score was (80% ≤ 100%), average knowledge (60% < 80%) and poor knowledge (< 60%).

**2nd Tool: Observational Practice Checklists:**

The observational practice checklists was adopted from the **Bloomfield et al., (2019),** that it is used to assess compliance of nurses toward the application of neonatal care protocol on mechanical ventilation in NICU. Standard checklists included 10 procedures which consisted of 125 steps and were used to assess nurses' practices regarding scraping (11 steps), percussion and vibration (16 steps), suctioning (22 steps), oral care (13 steps), changing position (6 steps), endotracheal tube care (14 steps), nasogastric tube feeding (12 steps), routine ventilator care (12 steps), weaning from ventilator (10 steps), and extubation and re-Intubation (9 steps).

**Scoring system for practice:**

Total steps were 125, each step scored (1) for done step (correct and complete), and scored (0) for (incomplete or incorrect and not done step). These scores were converted into a percent. The total nurses' practices considered competent practices if it was ≥ 85% and incompetent practices if it was < 85%.

## Preparatory phase:

It included reviews of related literature and theoretical knowledge of various aspects of the study using books, articles, magazines, internet and periodicals to develop tools for data collection and get acquainted with the research problem.

### *Validity:*

Content validity was tested through panel of three experts from pediatric nursing department (2 from Faculty of Nursing, Helwan University and 1 from Faculty of Nursing, Ain Shams University) to ensure its validity for comprehensiveness, accuracy, clarity and relevance.

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***Reliability:***

Reliability of the tools was tested using Cronbach Alpha equal (0.793) for knowledge questionnaire sheet and (0.831) for observational practice checklists which means that the tools were reliable.

***Ethical considerations:***

Official permission for conducting the study was obtained from the Faculty of Nursing, Helwan university, Research and Ethics Committee. Official approvals were obtained from the directors of El Sheikh Zayed Al Nahyan Hospital to conduct this study after explaining the purpose of the current study. The nurses assured that the information collected would be treated confidentiality and that it would be used for the purpose of the study only and not for their evaluation. The researcher assured maintaining anonymity and confidentiality of the subject data.

## II) Operational Design:

The operational design of the current study presented the data which included preparatory phase, pilot study and field of work which includes sampling and data collection phases.

***Pilot study:***

A pilot study was carried out on 6 nurses to test the clarity, applicability, feasibility and relevance of the tools used and to determine the needed time for the application of the study tools. The nurses who were included in the pilot study were included in the study sample because no modification was done after conducting the pilot study.

***Fieldwork:***

- The actual fieldwork of this study was carried out over six months from the first of January 2023 up to the end of June 2023. The researcher was available for two days (Saturday & Tuesday) per week during morning and afternoon shifts. The researcher introduced herself to the studied nurses and explained the purpose of the study.
- Nurse were individually interviewed to assess their knowledge regarding the application of neonatal care protocol on mechanical ventilation was assessed by using knowledge questionnaire sheet (It took 25 minute to fulfil it) and nurses' practices regarding the application of neonatal care protocol on mechanical ventilation was assessed by using observational checklists to observe nurses during their actual practice (The nurses were not aware that the researcher was observing their performance during work and assessing their compliance. It took 40 minutes to assess each nurse).

## III) Administrative Design:

The necessary approval was obtained from neonatal intensive care unit administrator. A letter was issued to them from the Faculty of Nursing, Helwan University explains the purpose of the study and for obtaining the permission for conducting this study.

## IV) Statistical Design:

The collected data were organized, categorized, tabulated and statistically analyzed using the statistical package for social science (SPSS) for windows version 28 (SPSS, Chicago, IL) to assess nurses' level of knowledge and practices regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit. Data were tested for normality of distribution prior to any calculations. Continuous data were expressed in Mean ± Standard Deviation (SD), while categorical data were expressed in number and percentage. Data were presented in tables and graphs. The Chi-square ($X^2$) test was used for the comparison of variables with categorical data. The correlation coefficient test (r) was used to test for correlations between two variables with continuous data. The reliability (internal consistency) test for the questionnaires used in the study, was calculated using Cronbach's alpha test. Statistical significance was set at $p < 0.05$.

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## Results

**Table (1):** Number and Percentage Distribution of the Studied Nurses' regarding their Characteristics (n = 68)

| Items | n | % |
|---|---|---|
| **Age** | | |
| 20 < 25 | **33** | **49%** |
| 25 < 30 | 26 | 38% |
| 30 < 35 | 6 | 9% |
| 35 ≤ 40 | 3 | 4% |
| **Mean ± SD** | **24.07 ± 4.19** | |
| **Gender** | | |
| Male | 22 | 32% |
| Female | **46** | **68%** |
| **Qualifications** | | |
| Diploma in Nursing | 20 | 29% |
| Technical Institute of Nursing | **33** | **49%** |
| Bachelor's | 12 | 18% |
| Post Graduate Studies | 3 | 4% |
| **Years of experience in the NICU** | | |
| 2 < 5 | **37** | **55%** |
| 5 < 10 | 19 | 28% |
| 10 < 15 | 9 | 13% |
| ≥ 15 | 3 | 4% |
| **Mean ± SD** | **4 ± 2.7** | |
| **Job Title** | | |
| Staff Nurse | **35** | **51%** |
| Head Nurse | 33 | 49% |
| **Previous training about neonatal care protocol** | | |
| Yes. | 21 | 31% |
| No. | **47** | **69%** |

**Table (1)** shows that **number and percentage distribution of the studied nurses' regarding their characteristics**. It was observed that more than two-thirds (68%) of the studied nurses were female. Concerning age and qualification, nearly half (49%) of the studied nurses were between 20 to less than 25 years old, and had a technical institute of nursing, respectively. In relation to years of experience in the NICU, more than half (55%) of the studied nurses had 2 to 5 years. Regarding job titles, half (51%) of the studied nurses were staff nurses. In regards to previous training on neonatal care protocol, slightly more than two thirds (69%) of the studied nurses had not received training.

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 7, Month: September 2024, Available at: https://hijnrp.journals.ekb.eg/

**Table (2):** Number and Percentage Distribution of the Studied Neonates regarding their Characteristics (n = 44)

| Characteristics of the Neonates | n | % |
|---|---|---|
| **Age in Days:** | | |
| 1 < 10 | 8 | 18% |
| 10 < 20 | 15 | 34% |
| 20 ≤ 30 | **21** | **48%** |
| **Mean ± SD** | **14.66 ± 3.91** | |
| **Gender:** | | |
| Male | **30** | **68%** |
| Female | 14 | 32% |
| **Neonates Health Problems:** | | |
| Respiratory problem only | 14 | 32% |
| Respiratory problem with Cardiac problem | **25** | **57%** |
| Respiratory problem with Neurological problem | 5 | 11% |
| **Ventilator Mode:** | | |
| SIMV | 19 | 43% |
| CPAP | 3 | 7% |
| CMV | **22** | **50%** |
| **Duration on Mechanical Ventilation in Days:** | | |
| 1 < 5 | 11 | 25% |
| 5 < 10 | **20** | **45%** |
| 10 ≤ 15 | 8 | 18% |
| ≥ 15 | 5 | 11% |
| **Sedative Drug Use:** | | |
| Continuous sedation | 7 | 16% |
| Intermittent sedation | **22** | **50%** |
| No sedative | 15 | 34% |
| **Level of Consciousness:** | | |
| Conscious | 3 | 7% |
| Semi- conscious | 19 | 43% |
| Un-conscious | **22** | **50%** |

**Table (2)** shows that, **the number and percentage distribution of the studied neonates regarding their characteristics**. It can be observed that less than half (48% & 45%) of the studied neonates were aged between 20 to less than 30 day and on mechanical ventilation from 5 to less than 10 days, respectively. In addition, more than two thirds (68%) of the studied neonates were males and more than half (57%) had respiratory problem with cardiac problem. Moreover, half (50%) of the studied neonates on CMV mode, intermittent sedation, and unconscious, respectively.

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Vol. 3, Issue 7, Month: September 2024, Available at: https://hijnrp.journals.ekb.eg/

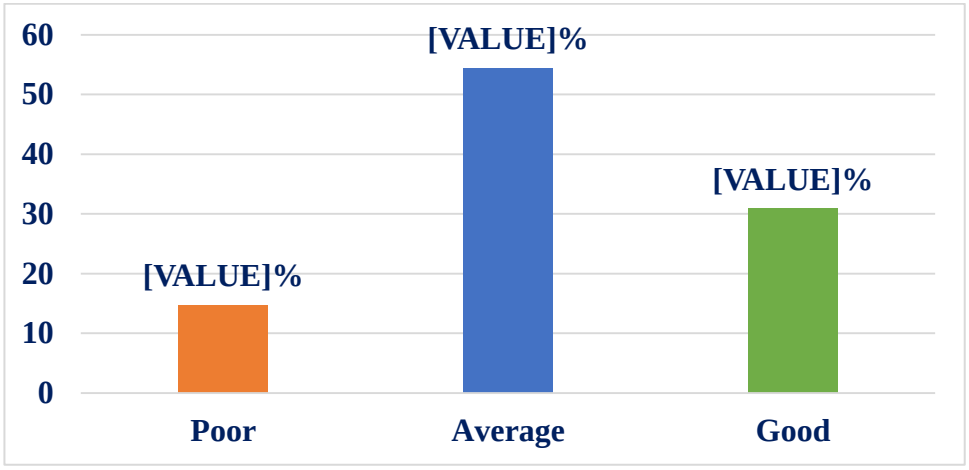


**Figure (1):** Percentage Distribution of Total Level of the Studied Nurses' Knowledge regarding the Application of Neonatal Care Protocol on MV (n = 68)

**Figure (1)** this figure illustrates that, **the percentage distribution of total level of the studied nurses' knowledge regarding the application of neonatal care protocol.** It can be noted that more than half (54%) of the studied nurses' had average level of knowledge, followed by about less than one third (31%) of the studied nurses' had good level of knowledge. While, the lowest percent (15%) of the studied nurses' had poor level of knowledge regarding the application of neonatal care protocol on mechanical ventilation in NICU.

**Part (III): Nurses' Practices regarding the Application of Neonatal Care Protocol on Mechanical Ventilation in NICU:**

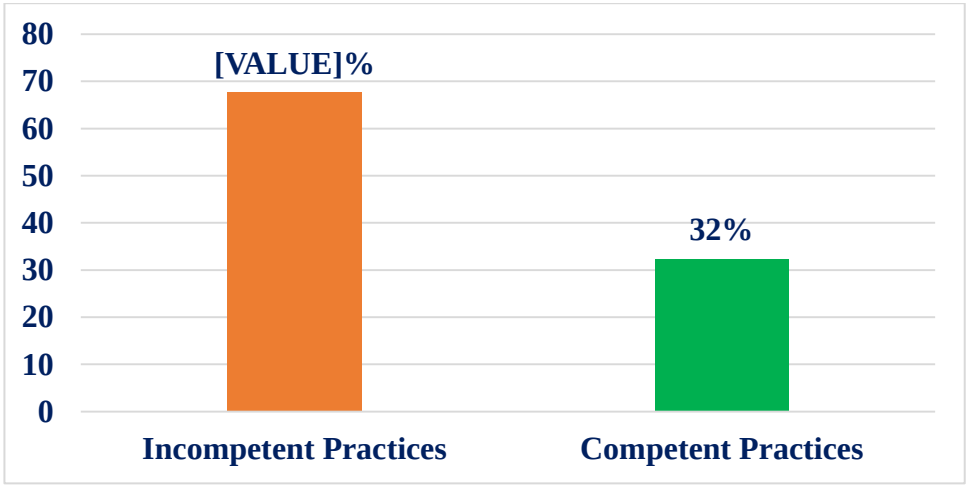


**Figure (2):** Percentage Distribution of Total Level of the Studied Nurses' Practices regarding the Application of Neonatal Care Protocol on MV (n = 68)

**Figure (2)** this figure illustrates that more than two thirds (68%) of the studied nurses' demonstrated incompetent level of practices, while, nearly one third (32%) of the studied nurses demonstrated competent level of practices regarding the application of neonatal care protocol on mechanical ventilation in NICU.

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 7, Month: September 2024, Available at: https://hijnrp.journals.ekb.eg/

**Table (3):** Association between Total Level of the Studied Nurses' Knowledge and their Characteristics (n = 68)

| Items | Total Level of Knowledge | | | | | | $X^2$ | P - Value |
|---|---|---|---|---|---|---|---|---|
| | Poor | | Average | | Good | | | |
| | n | % | n | % | n | % | | |
| **Age:** | | | | | | | | |
| 20 < 25 | 5 | 15% | 19 | 58% | 9 | 27% | 1.841 | **0.487** |
| 25 < 30 | 4 | 15% | 12 | 46% | 10 | 38% | | |
| 30 < 35 | 1 | 17% | 3 | 50% | 2 | 33% | | |
| 35 ≤ 40 | 0 | 0% | 3 | 100% | 0 | 0% | | |
| **Gender:** | | | | | | | | |
| Male | 7 | 15% | 26 | 57% | 13 | 28% | 0.561 | **0.311** |
| Female | 3 | 14% | 11 | 50% | 8 | 36% | | |
| **Qualifications:** | | | | | | | | |
| Diploma in Nursing | 2 | 10% | 12 | 60% | 6 | 30% | 7.212 | **0.045*** |
| Technical Institute of Nursing | 6 | 18% | 16 | 48% | 11 | 33% | | |
| Bachelor's | 1 | 8% | 8 | 67% | 3 | 25% | | |
| Post Graduate Studies | 1 | 33% | 1 | 33% | 1 | 33% | | |
| **Years of working experience in the NICU:** | | | | | | | | |
| 2 < 5 | 5 | 14% | 21 | 57% | 11 | 30% | 15.374 | **0.006**** |
| 5 < 10 | 3 | 16% | 9 | 47% | 7 | 37% | | |
| 10 < 15 | 1 | 11% | 6 | 67% | 2 | 22% | | |
| ≥ 15 | 1 | 33% | 1 | 33% | 1 | 33% | | |
| **Job Title:** | | | | | | | | |
| Staff Nurse | 5 | 14% | 18 | 51% | 12 | 34% | 1.514 | **0.678** |
| In charge Nurse | 5 | 15% | 19 | 58% | 9 | 27% | | |
| **Previous training neonatal care protocol:** | | | | | | | | |
| Yes | 4 | 19% | 10 | 48% | 7 | 33% | 2.101 | **0.166** |
| No | 6 | 13% | 27 | 57% | 14 | 30% | | |

**P - Value > 0.05 was considered insignificant, * P - Value ≤ 0.05 was considered significant, ** P - Value ≤ 0.001 was considered as highly significant.**

**Table (3)** this table reveals that there is a statistically significant relation between nurses' qualifications and their total knowledge levels, as the p-value (0.045*). In addition, There is a highly statistically significant relation between years of experience in the NICU and their knowledge levels, as the p-value (0.006**). Moreover, there is no significant relations between age, gender, job title, previous training and nurses' knowledge levels.

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**Table (4):** Association between Total Level of the Studied Nurses' Practices and their Characteristics (n = 68)

| Items | Total Level of Practice | | | | P - Value |
|---|---|---|---|---|---|
| | Incompetent Practice | | Competent Practice | | |
| | No. | % | No. | % | |
| **Age:** | | | | | |
| 20 < 25 | 24 | 73% | 9 | 27% | **0.006**** |
| 25 < 30 | 18 | 69% | 8 | 31% | |
| 30 < 35 | 3 | 50% | 3 | 50% | |
| 35 ≤ 40 | 1 | 33% | 2 | 67% | |
| **Gender:** | | | | | |
| Male | 14 | 64% | 8 | 36% | **0.898** |
| Female | 32 | 70% | 14 | 30% | |
| **Qualifications:** | | | | | |
| Diploma in Nursing | 15 | 75% | 5 | 25% | **0.052*** |
| Technical Institute of Nursing | 20 | 61% | 13 | 39% | |
| Bachelor's | 9 | 75% | 3 | 25% | |
| Post Graduate Studies | 2 | 67% | 1 | 33% | |
| **Years of working experience in the NICU:** | | | | | |
| 2 < 5 | 27 | 73% | 10 | 27% | **0.002**** |
| 5 < 10 | 10 | 53% | 9 | 47% | |
| 10 < 15 | 7 | 78% | 2 | 22% | |
| ≥ 15 | 2 | 67% | 1 | 33% | |
| **Job Title:** | | | | | |
| Staff Nurse | 25 | 71% | 10 | 29% | **0.018*** |
| In charge Nurse | 21 | 64% | 12 | 36% | |
| **Previous training neonatal care protocol:** | | | | | |
| Yes. | 32 | 68% | 15 | 32% | **0.821** |
| No. | 14 | 67% | 7 | 33% | |

**P - Value > 0.05 was considered insignificant, * P - Value ≤ 0.05 was considered significant, ** P - Value ≤ 0.001 was considered as highly significant.**

**Table (4)** this table reveals that there is a statistically significant relations between nurses' qualifications, job title and their total practice levels, as the p-value (0.052* & 0.018*). In addition, There is a highly statistically significant relations between age, years of experience in the NICU and their practice levels, as the p-value (0.006** & 0.002**). Moreover, there is no significant relations between gender, previous training and nurses' practice levels.

**Table (6):** Correlation between Total Level of the Studied Nurses' Knowledge and Total Level of the Studied Nurses' Practices (n = 68)

| Items | Total Level of Knowledge | |
|---|---|---|
| | r | P. value |
| **Total Level of Practice** | **0.128** | **0.001**** |

**P - Value > 0.05 was considered insignificant, * P - Value ≤ 0.05 was considered significant, ** P - Value ≤ 0.001 was considered as highly significant.**

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**Table (6) This table** indicates that there is a positive correlation between the nurses' total level of knowledge and their total level of practice as the Pearson correlation coefficient is (r = 0.128) at (P = 0.001), as the level of knowledge increases, the level of practice tends to increase

## Discussion

The results of this study covered the main areas that were discussed within the following frame of reference: First, the characteristics of the studied nurses and neonates. Secondly, actually nurses knowledge and practices regarding the application of neonatal care protocol on mechanical ventilation. Thirdly, association between total level of the studied nurses' knowledge, and practices with their characteristics. Fourthly, the correlation between the studied variables.

Nurses caring for neonates on mechanical ventilation faced numerous challenges. Expertise and extreme care are significant aspects in providing safe and effective nursing care to improve the quality of nursing care provided for them in order to raise the survival rate for these neonates, decrease morbidity and mortality rates. They also must provide a safe environment for these neonates in the unit and follow the infection control policies **(El-Sayed et al., 2023).**

This study aimed to assess nurses' compliance regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit through assessing the level of nurses' knowledge and practices regarding the application of neonatal care protocol on mechanical ventilation in intensive care unit.

Regarding characteristics of the studied nurses. The present study findings that, nearly half of the studied nurses had a technical institute of nursing, while more than one quarter had diploma in nursing. The findings was nearly in accordance with a study conducted by **Ebrahim et al., (2023),** entitled "Nurses' knowledge Regarding Care Provided to Children on Mechanical Ventilation" in Egypt, who reported that; nearly less than half of studied nurses was graduated from nursing technical institute while, one third was obtained bachelor degree of nursing. The researcher believed that, the technical nursing institute provides the hospitals with a large number of technical institute nurses graduates than faculties of nursing.

The results of current study revealed that, more than half of the studied nurses had two to less than five years of experience while, nearly more than one quarter had between five and less than ten years of experience. The results disagree with those of **Kunswa and Mohamed, (2021),** who studied the "Effect of Instructional Guidelines on Nurses' Performance regarding Care of High Risk Neonates Undergoing Extubation of Mechanical Ventilator" in Egypt, which showed that; more than one third of studied nurses had one to less than five years of experience. From the researcher point of view, this difference may be due to most of the studied nurses working at NICU were newly graduated and contract workers.

Regarding previous training, the results of present study showed that, slightly more than two thirds of the studied nurses had not received training about neonatal care protocol. These results was agreed with study conducted by **Mohammed et al., (2023),** who studied "Nurses' Knowledge and Practices Regarding Care of High-Risk Neonates Connected with Mechanical Ventilator" in Egypt, and reported that, over two-thirds of the nurses did not receive training on the care of high-risk neonates in relation to mechanical ventilator. From the researcher's opinion, this may be due to shortage of staff and workload in NICU, and no announce to neonatal course.

Regarding characteristics of the studied neonates, the present study findings revealed that less than half of the studied neonates were in the age range from 20 ≤ 30 days with a Mean ± SD of 14.66 ± 3.91, in addition more than half had respiratory problem with cardiac problem, and half of the studied neonates were on CMV mode ventilation. this result is nearly similar to that of the study carried out by **Hendy et al., (2020),** whose study entitled "Nursing Competency for Caring of High-Risk Neonates at Neonatal Intensive Care Unit" in Egypt, reported that the mean age of them was 12.2±7.4 days. However nearly two thirds of them were connected on mechanical ventilation, and half of them diagnosed as respiratory distress syndrome. This may be related to different studied neonates' samples, areas, environmental characteristics, and variable classification.

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 7, Month: September 2024, Available at: https://hijnrp.journals.ekb.eg/

Concerning to total level of nurses' knowledge, the present study illustrated that, more than half of the studied nurses' had average level of knowledge, followed by about less than one third of the studied nurses' had good level of knowledge. While, the lowest percent of the studied nurses' had poor level of knowledge regarding the application of neonatal care protocol on mechanical ventilation in NICU.

This finding was contradicted with a study conducted by **Hegazy and Abusaad, (2019)** who studied "Nurses, Knowledge and Practices about Care of Neonates on Mechanical Ventilators with Respiratory Distress", in Egypt, and reported that; less than two third of the studied nurses had average level of knowledge compared to less than one quarter of them had good level of knowledge. While, the minority of them had poor level of knowledge regarding care of neonates with respiratory distress on mechanical ventilators. The researcher suggested that, this finding is due to that nearly half of the studied nurse had a technical institute of nursing as well as, slightly more than two thirds of the studied nurses had not received training about neonatal care protocol. This result could be due to workload on nurses and shortage in staff may kept them had no more time to attend any training program.

In relation to total level of nurses' practices, the present study clarifies that, more than two thirds of the studied nurses' demonstrated incompetent level of practices, while, nearly one third of the studied nurses demonstrated competent level of practices regarding the application of neonatal care protocol on mechanical ventilation in NICU. This finding was highly supported with a study conducted by **Hegazy & Abusaad (2019)**, who reported that; more than two thirds of the studied nurses had incompetent practical level compared to less than one third of them had competent practical level regarding care for neonates with respiratory distress on mechanical ventilation.

Additionally, this findings was in constant with study conducted by **Hendy et al., (2020),** who reported that; slightly more than three quarters of nurses were incompetent in care for high risk neonates on mechanical ventilation. The researcher believes that, this finding may be due to training team in the hospital give oral lectures only without practical training for nurses and not follow the effect of training on their practice. Moreover, lack of knowledge, work over load, shortage of staff and absence of close supervision are probably resulting in incompetent nurses' practice.

Concerning to relations between total level of the studied nurses' knowledge and their characteristics, there was a highly statistical significant relation between nurses' knowledge scores and years of experience of the studied nurses regarding the application of neonatal care protocol on mechanical ventilation in the intensive care unit. This result is in agreement with a study by **El-Garhy et al., (2020)**, who revealed that, there was a statistically relation between the total nurses' knowledge with years of experience.

There was a statistically significant relation between level of nurses' knowledge scores and qualifications of the studied nurses. This findings was consistent with recent study conducted by **Ebrahim et al. (2023)**, who reported that; there was highly statistically significant relation between nurses` total knowledge score and their qualifications. From the researcher point of view, this finding might be due to that more than half of the studied nurses had two to five years and half of the studied nurses had technical institute of nursing which significantly affected their level of knowledge.

Regarding to relations between total level of the studied nurses' practices and their characteristics, the current study revealed that, there was a highly statistical significance relations between total nurses' practice scores and their age, years of experience. This findings was in consistent with study conducted by **Mustafa et al., (2019)**, who reported that; there was a statistically significant relation between nurses' level of practice and years of experience. The researcher inferred that, years of experience enable neonatal nurses to master skills competently. However, this may be related to older nurses depend on younger nurses in work and they assigned for administrative work only.

The current study revealed that, there was a statistically significant relation between the nurses' level of practice and qualifications and job title of the studied nurses. The findings was in agreement a with study conducted by **(Thabet et al., 2021)** entitled "Influence of Training Program Implementation on Nurses' Performance Regarding Neonates Invasive Mechanical Ventilation" in Egypt, whom revealed that; there was a

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 7, Month: September 2024, Available at: https://hijnrp.journals.ekb.eg/

statistically significant relation between nurses' total level of practice and their qualifications. From the researcher point of view, this finding might be due to that half of the studied nurses had technical institute and were staff nurses which significantly affected their level of practices.

As regard to the correlation between studied total nurses' knowledge and practice. The current findings indicated a positive correlation between the nurses' total level of knowledge and their total level of practices. This finding was aligned with a study conducted by **Mahfoz et al., (2022)**, who reported that; there was a highly statistically significant corelation between the total score of the studied nurses' level of knowledge and their practice. Additionally, this result is in agreement with a study by **El-Garhy et al., (2020)**, who revealed that, there are highly statistical significant correlation between the studied nurses' total knowledge and their total practice level. This finding might be due to that, the nurses with adequate knowledge do better professional practice in their work. The researcher inferred that, these positive correlation reflects that the higher level of nurses' knowledge lead to better level of practice, which increase quality of care and improve neonatal outcome.

## Conclusions

**Based on the results it can be concluded that,** More than half of the studied nurses' had average level of knowledge, followed by about less than one third of the studied nurses' had good level of knowledge. While, few of the studied nurses' had poor level of knowledge. In addition, more than two thirds of the studied nurses' demonstrated incompetent level of practices, while, nearly one third of the studied nurses demonstrated competent level of practices regarding the application of neonatal care protocol on mechanical ventilation in NICU. . In addition, there is a highly statistically significant relation between years of experience in the NICU and their knowledge levels. Moreover, there is no significant relations between gender, previous training and nurses' practice levels.

### Recommendations

**In the light of the study results, the following recommendations are suggested:**

- Develop a nursing protocol for the application of mechanical ventilation and provide nurses with updated evidence-based practices.
- Provide adequate supervision of nurses during their practice, including on-the-spot teaching, motivation, and feedback.
- Ensure that manual handbooks, updated pamphlets, posters, and Arabic booklets containing essential information about neonatal care protocols for mechanical ventilation are readily available to nurses in NICUs.
- Encourage nurses to attend workshops and audiovisual conferences on practical procedures to increase their awareness of recent approaches.
- Regularly schedule assessments to evaluate the knowledge and practices of all nurses regarding the application of protocols for mechanically ventilated neonates.
- Conduct further studies to assess the factors affecting nurses' performance in the NICU for neonates undergoing mechanical ventilation.

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