

**Impact of Safety Guidelines on Nurses' Knowledge regarding Incidents and Nurses' Safety Attitude at Neonatal Intensive Care Unit**  
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**Abstract**

**Background:** Patient safety has become a top issue in the global health-care quality agenda. **Aim:** The study aimed to explore the impact of safety guidelines on nurses' knowledge regarding incidents and nurses' safety attitude at Neonatal Intensive Care Unit. **Subject & Methods:** A quasi-experimental research design was used to conduct the study at three capital neonatal intensive care units. Thirty-three nurses were recruited for this study using purposive sampling technique. Data were collected using: (I) Safety Attitudes Questionnaire, (II) Incident sheet, and (III) Nurses' safety knowledge questionnaire /pre and posttest. **Results:** According to the study's findings, 69.3 % of nurses indicated a positive attitude toward the teamwork climate and 35.1 % of the most common incidents recorded were invasive procedure. In addition, there was highly statistical significant difference in the nurses' total knowledge before and after the educational guidelines intervention. **Conclusion:** This study concluded that, a low positive attitude in most areas toward safety was reported by the nurses. As well, the most incidents reported were invasive procedures and respiratory care errors resulted in minor problems. The guidelines program intervention was effective for improving nurses' knowledge about neonatal safety measures. **Implications for clinical practices:** Nurse practitioners should apply incident reporting systems that are a key strategy to learn from incidents and monitor progress in the prevention of medical errors recurrence. It is necessary to train neonatal nurses and supervisors in relation patient safety competency.

**Keywords:** Safety attitude, Incidents, Neonatal intensive care unit, Safety guidelines.

**Introduction**

Medical errors and their negative impact on health are gaining increasing interest around the world. Neonatal Intensive Care Units (NICUs), recognized as a high sensitive environment, which signals the importance of healthcare team awareness about the causation of incidents.

Recently, the safety of neonatal ICU patients appears to be a top priority on the healthcare quality agenda. Unfortunately, medical errors still present and unavoidable in highly complex health setting like NICU<sup>(1)</sup>. Medical errors, known as incidents, accidents and adverse events, can cause severe harm or death. The effect of these errors can be reduced thorough

causative identification approach followed by detailed analysis of its consequences and prevention measures<sup>(2)</sup>. Nowadays neonate safety improvement become a key focus of clinical care and research. The patient safety climate of an institution is critical element of ensuring safe environment and, as a result, consider critical key in preventing adverse events. Measuring the safety climate is significant since it has been shown that an organization's culture and team attitudes influence patient safety results, and it can be used to track change over time<sup>(3,4)</sup>.

Because patient safety is so important in healthcare, NICU nurses should be conversant with the unit's safety procedures, apply best practices, promote a safety culture, and maximize efforts to reduce errors. Moreover, top management commitment developing a patient safety culture is crucial in order to achieve the desirable organizational safety outcomes<sup>(5)</sup>

Neonatal nursing is a sub-specialty of nursing that works with baby born with a range of problems. It encompasses care for these neonates who experiences problems quickly after the first preliminary hours of start till 28 days of life. So, it is in truth essential for nurses to bear training that now not only enhance knowledge, but deliver exchange in behavior by using retaining accountability to care neonates and to meet general to particular needs. In the NICUs, nurses are in charge for introducing special, immoderate high quality and safe care for infants. Therefore, it is crucial their

information and competencies associated with protection come to be part of nurses' functions and each day habits<sup>(1,6)</sup>.

Despite these, the patient safety idea as an imperative part of patient care has yet to permeate aspect of the neonates' care. As well as, it has yet to become a trendy part of the curriculum in the nursing educational settings. Although case and observational studies proceed to record errors and neonate harm throughout ongoing care, additional research is wanted to apprehend the causes, consequences and evidence-based finding to eliminate neonatal intensive care-related incidents<sup>(7)</sup>.

#### **Significance of the study**

Patient safety concerns have acquired extra attention from the health scientific community and national organizations, however little information is available on claims of neonatal malpractice. Although critical care settings provide vital care to high-risk newborns, they combine with considerable dangers of unfavorable risks of incidents and serious medical errors. Hence, it is critical to study the safety culture condition, the attitude of nurses and their knowledge about national neonatal safety guidelines and understand the common factors that contribute to the occurrence of the error and provides the fundamental data essential for improving neonates' safety. To address these problems, this research highlighted the impact of the safety guidelines intervention on nurses' knowledge and studies their safety attitude for a future research agenda.

### **Aim of the study**

The study aimed to explore the impact of safety guidelines on nurses' knowledge regarding incidents and nurses' safety attitude at Neonatal Intensive Care Unit.

### **Study Hypothesis**

H<sub>1</sub>: Nurses are expected to have a positive attitude regarding patient safety at NICU.

H<sub>2</sub>: Nurses' knowledge regarding neonatal safety measures will be expected to improved post implementation of the safety guidelines.

### **Subject and methods**

#### **Research design**

A quasi-experimental research design was utilized to accomplish this study.

#### **Sample size and sample technique**

The participants in this study recruited using the purposive sampling technique. The sample consisted of 33 nurses working in the NICUs affiliated to Beni-Suef, Minia and Benha university hospitals, following these criteria; accepted to participate in the study, both sex included, any age, having at least 6 months' experiences in NICU and responsible for providing direct care for the neonates with any health problems.

#### **Data collection tools**

In order to achieve the aim of this study, three instruments were utilized for data collection including:

**I: Safety Attitudes Questionnaire (SAQ):** it is a short adapted 30-item version was designated by (Sexton et al., 2006)<sup>(8)</sup>. This questionnaire comprises two parts. The first part

contains questions that address perceptions of patient's safety and the second part collects data about the professional respondent, including position held, sex, main job and years of experience. The instrument measures healthcare professionals' perceptions in six areas, the teamwork climate, the safety climate, job satisfaction, perceptions of management, stress recognition and working conditions, with a response is Likert scale ranging from: 1=disagree strongly, 2=disagree slightly, 3=neutral, 4=agree slightly, 5=agree strongly

The respondent who got a score of 75 or higher was considered to have positive attitude and those who had score less than 75 is considered to have negative attitude toward patient safety. The total domain score was calculated by summing all items in each domain then divided by the number of items with the conversion to the 100-point scale: 1=0, 2=25, 3=50, 4=75, 5=100.

**Content validity reliability of the SAQ:** Cronbach's alpha was calculated for each factor of the SAQ. Values of Cronbach's alpha exceeding 0.70 indicate adequate internal consistency. Additionally, inter-item correlations and correlations between items and corresponding factor scores were calculated to examine the internal consistency reliability of SAQ, correlations greater than 0.30 indicate good reliability. Validity evidence based on content was evaluated by calculating scale and item level content validity indexes. The scale-level content validity index was 0.83, indicating good content validity. For

most of the items was also good, ranging between 0.78 and 0.95.

**II: Incident sheet:** This tool designed by the researchers after reviewing the relevant literature (Snijders et al., 2007).<sup>(9)</sup> Incidents were collected with the direct continuous observation of nurses or nurses’ notes. The sheet includes incident type, severity, and time of occurrence. Nurses raters judged severity on a three-point Likert scale, minor (no interventions required), moderate (requiring routine therapy), major (need for intensive care specific to the ICU). Observations on incidents progress were done by the nurses who used the sheet weekly for six months with a list of possible medical errors.

**III: Nurses' Knowledge Structured Questionnaire:** It was designed by the researchers; and prepared based on **Egyptian Neonatal Safety Standers (2014)** <sup>(10)</sup>. It was consisted of 100 structured questions, concerning safety measures knowledge about infants’ identification (5 item), ventilator care/oxygen therapy (10 items), invasive procedures (20 items), acquired infections in NICU prevention (15 items), diagnostic and sample errors (10 items), skin lesion and trauma (6 items), safely medication and total parenteral nutrition (20 items), reduce the risk of fires (9 items), safe transfer for newborn (5 items). The score for each question allotted as follows:

Answer	Score
correct	1
Incorrect/unknown	0
Total scores	100

**Validity and reliability:** The tool validity test was done through five panels of expertise; they are faculty members of pediatric nursing departments. In order to check the validity of the knowledge and practice regarding neonatal safety items in the current study, the data collection tool, applied to a pilot sample consist of 5 nurses. The sample was selected randomly from the study population. After the responses, Pearson correlation was conducted to get correlation coefficients between scores of each item and the total score of the items in which the item belonging to. This helped in determining the consistency of the questionnaire. The correlation coefficients ranging (.464-.732). The reliability of the tool was computed using a split - half method ( $r=0.84$ ), this method was used to assess the homogeneity of the tool.

**Ethical consideration**

The present study was approved by the institutional ethical committee board of Faculty of Nursing, Benha University, and the study aim explained to the nurses before obtaining their written consent. Written consent outlined voluntary participation and anonymity. The nurses reminded that they have a right to withdraw whenever they wished and that the study results will be used solely for research purposes.

### Field work

The study conducted from 1<sup>st</sup> April 2020 up to the end of September 2021. After official permission was obtained, the researchers started by explaining the study purpose briefly to the nurses and how to fill the questionnaires and incidents sheet. In this phase the researchers started recruiting the sample to using SAQ to determine the safety attitude. These questionnaires were filled by the nurses. Data has collected through the questionnaire and interview techniques.

Subsequently, eligible nurses were met, and invited to participate in the educational program, all nurses approved to join the program. Before implementing the safety guidelines program, areas of weaknesses of the nurses' knowledge were identified and the objectives set. The researchers designed a safety education program contents based on Egypt national safety standers

Those who gave their consent to participate in this study were interviewed using the knowledge questionnaire form, including pre-and post-test. The program intervention done through eight sessions, the patient safety measures discussed were: prevention of the identification errors, uses medicines safely in NICU such as dose, administration technique, wrong route/medication error, omission & commission; wrong site prevention, wrong patient and wrong procedures; reduced risk of healthcare acquired infections. In addition, reduce the risk of newborn accidental fall; safe

transfer; using well-functioning machines and equipment, use monitor alarms safely; reduce the risk of the fires; mechanical ventilation/intravascular lines connection and disconnections safety guidelines. Immediately after the program intervention, the knowledge questionnaire posttest done to evaluate the nurses' knowledge improvement (tool III).

### Statistical analysis

Data was organized, entered and analyzed by using SPSS software (Statistical Package for Social Science) version 16. Graphics were done using Excel program. Quantitative data were expressed as mean & standard deviation ( $X \pm SD$ ) and analyzed by using T-test. Enumeration data were analyzed by the chi-square test.  $P < 0.05$  was considered as a level of statistical significance.

### Results

**Table (1)** showed that, the studied nurses consisted of 15.1% males and 84.9 % females. Among them, 69.8 % nurses had technical nursing institute. Most of the nurses were 26-30 years of age. As well, 60.6% of nurses' experience were less than 5 years. The same table indicated that only 9.1 % of nurses have attended specific course/ training in neonatology, and 100% of them reported no incidents reporting system within NICU.

**Figure (1)** showed the percentage of nurses who reported positive attitude was 69.3% of the teamwork climate, 57.2% of the safety climate, 53.4% of job satisfaction, 35.4% of stress

recognition, 59.3% of the perception of management and 49.5% of working conditions.

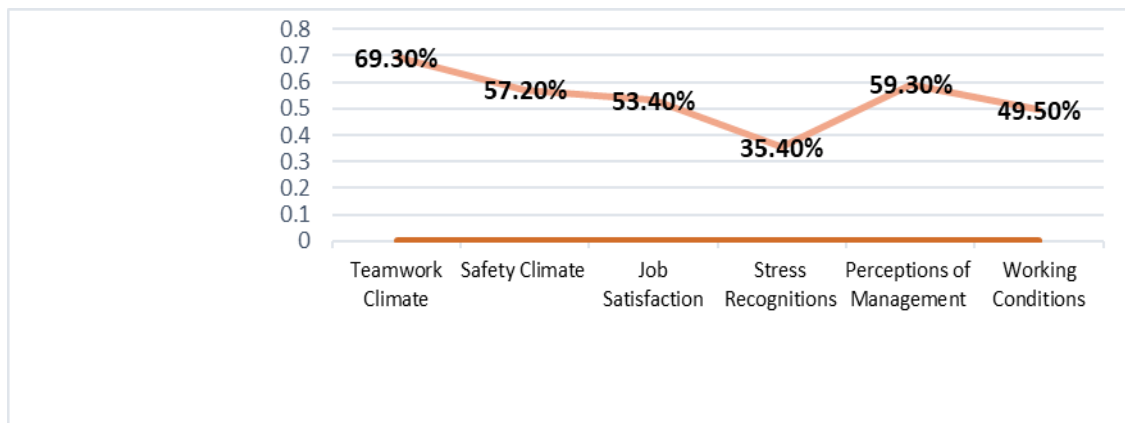
As obvious from **table (2)** that, there was a significant statistical correlation between age of nurses, their years of experience and their positive scored in relation to safety climate where  $P = (0.05, .001)$  respectively.

**Table (3)** showed the percentage of the common incident reported in the NICUs were invasive procedure, 35.08 %, respiratory care and ventilator care-related errors 21.05%, skin lesions 17.54%, medication and total parenteral nutrition errors 14.03%, infection control errors 10.52%. As well as, 70.17% of incidents had minor harm. The same table showed that, 66.31% of incidents occurred during ongoing care.

**Table (4)** documented that, the total mean score of nurses' knowledge pre and post program intervention, it was  $59.3 \pm 5.87 - 76.4 \pm 8.42$  respectively and it revealed high statistical significant improvement post-intervention ( $P = 0.00$ ).

**Table (1): Socio demographic characteristics of the studied nurses (total n=33)**

Sample characteristics	No.	%
<b>Gender</b>		
Male	5	15.1
Female	28	84.9
<b>Age (years)</b>		
20-25	3	9.1
26- 30	25	75.7
31- 40	3	9.1
≥40	2	6.1
<b>Mean ± SD (26. 17±7. 12 )</b>		
<b>Educational level</b>		
Diploma	5	15.1
Technical nursing institute	23	69.8
Bachelor degree	5	15.1
<b>Experience years</b>		
Less 5	20	60.6
5 – 10	7	21.2
10 – 15	4	12.1
More than 15	2	6.1
<b>Training courses</b>		
Yes	3	9.1
No	30	90.9
<b>Incidents reporting system applied at NICU</b>		
Yes	0	0.0
No	33	100



**Figure (1): Percentage of the nurses' positive responses per SAQ areas.**

**Table (2): Correlation between characteristics of the nurses and SAQ subscales scores**

study characteristic	F	Sig.	F	Sig.	F	Sig	F	Sig	F	Sig	F	Sig
Age of nurses	1.412	.259	6.36	.005*	.972	.390	.015	.985	.384	.685	4.860	.015
Years of experiences	9.608	.000**	6.57	.001**	.221	.925	.604	.663	3.307	.024	3.874	.013
Works Hours	.358	.554	.005	.942	.546	.465	4.776	.037	.004	.950	2.651	.114
Educational level	4.221	.024	2.369	.111	.568	.573	.128	.881	5.321	.011	3.476	.044

\*p &lt; .05 significant correlation

\*\*p &lt; .001 high statistical significant

**Table (3): Incidents types, severity and time of occurrence in NICUs reported by nurses**

Incidents types (total 285 incidents )	No.	
Medication and total parenteral nutrition errors	40	14.03
Respiratory care and ventilator care-errors	60	21.05
Invasive procedures errors	100	35.08
Infections control errors	30	10.52
Diagnostic and sample errors	5	1.75
Skin lesion and trauma	50	17.54
<b>Incidents severity</b>		
Severe	35	12.28
Moderate	50	17.54
minor	200	70.17
<b>Time of occurrence</b>		
Admission	9	3.16
Ongoing care	189	66.31
Emergency	76	26.67

\*Number is not exclusive

**Table (4): Mean scores of nurses' knowledge about safety measures in NICU pre-and post-program intervention (N=33)**

National Safety measures knowledge	Pretest	Posttest	P value
	Mean ±SD	Mean ±SD	
• Newborn ' identification safety	4.03±.76	4.53±.16	.069
• Ventilator care/oxygen therapy safety	4.21±1.31	8.21±.78	.000**
• Invasive procedures safety	11.93±2.55	16.23±1.3	.000**
• Acquired infections	10.51±1.8	13.91±.23	.027
• Diagnostic and sample errors	4.84±1.62	8.04±.06	.000**
• Skin lesion and trauma prevention	3.09±1.30	5.09±.30	.000**
• Safely Medication and TPN	11.87±2.4	17.08±1.6	.000**
• Reduce the risk of fires in NICU	5.36±.03	7.04±1.73	.000**
• Safe transfer for newborn	3.50±.62	4.13±.31	.000**
<b>Total knowledge</b>	<b>59.3±5.87</b>	<b>76.4±8.42</b>	<b>.000**</b>

\*\* Highly significant at P &lt; 0.01



## Discussion

The present study is figuring out that, most the nurses were female and had experienced less than 5 years. Regarding their education, the result revealed that the rest of them achieved their college nursing education. In addition, the majority of them did not attain any course or training program in relation to patient safety. These results are consistent with findings from previous studies done by **El Sayed et al., (2013)**<sup>(11)</sup> who highlight that, most the nurses are secondary nursing school graduates, and didn't attend any previous in-service training program about neonatal care.

Concerning the application of the safety attitude questionnaire, the current study findings confirmed that, most of nurse presented positive safety attitude in relation team work safety, and nearly half of them had positive attitude about climate safety, job satisfaction and the perception of management. This finding goes on line with another study done by **Hemmat et al., (2015)**<sup>(12)</sup> about the determining the perception of patient safety culture, and found that, nurses' positive response mean score to the 12 areas of patient safety culture was high. As well, in a research performed in France by **Scherer and Fitzpatrick (2008)**<sup>(13)</sup> entitled perceptions of patient safety culture among physicians and nurses in the perioperative area, found that teamwork dimension in the unit obtained the highest positive response rate.

Additionally, these findings showed that less than half of nurses had a positive attitude in relation job satisfaction, and stress recognition. This finding agreed with **Canadian Patient Safety Institute, (2011)**<sup>(14)</sup> it referred to that, in healthcare settings, a significant percentage of errors are attributed to a lack of effective administration team. Another study done by **Needleman, et al., (2002)**<sup>(15)</sup> that examined nurses' job satisfaction and documented that less than half of nurses were dissatisfied with their work. This finding supported by a study done by **Gabrani (2013)**<sup>(16)</sup> who observed that the international benchmark standards of patient safety have been not met, as evidenced by the low mean values in relation to the five safety dimensions. The findings of this study showed a significant correlation between age of the nurses, their years of experience with their

positive attitude percentage in relations teamwork climate, and safety climate.

Based on researchers' point of view, increasing positive safety attitude for nurses by improving team management, job satisfaction and good communication are crucial and can lead benefits such as reducing the treatment errors, enhancing patient safety, and improving the quality of healthcare services. In this context, **Ausserhofer et al., (2013) and Tavares et al., (2018)**<sup>(17,18)</sup> pronounced that poor communication and ineffective teamwork are elements that contribute to the occurrence of patient safety incidents.

Study findings illustrated that, there were 285 incidents reported within 6 months in the selected NICUs. Invasive technique errors presented the most frequent incident type, constitute one third of the total number of medical errors. This was followed by respiratory procedure incidents, including intubation, mechanical ventilation, and nasal prong technique. This is may be due to that high risk neonates had high length of stay and required complex invasive maneuvers, so they had more chance for medical errors, in addition to lack of the nurse competency level. These results are consistent with other studies done by **Ligi et al., (2008) and El-Shazly et al., (2017)**<sup>(19,20)</sup> about medical errors in neonatal intensive care unit, they showed that invasive procedures incidents were the most frequent type of medical malpractice, constituting 27.28% of the total number of errors followed by endotracheal intubation incidents.

On the other hand, results of this study showed that, medication error constitutes 17.02 % of the total errors followed by skin trauma. This finding goes on line with **Stavroudis et al., (2010)**<sup>(21)</sup> they reported that, in NICUs medication errors occur eight times more often, raising the chance to cause severe danger. In this perspective, **Snijders et al., (2011)**<sup>(22)</sup> reported that incidents concerning mechanical ventilation, parenteral nutrition and medication dosing errors consider the highest risk to NICU patients.

Moreover, the study results showed that, most reported incidents were minor and not need any intervention. Similar studies done by **Kugelman et al., (2008) and Singer & Vogus, (2013)**<sup>(23,7)</sup> revealed that most of the incidents were

classified as minor. In our opinion identifying errors should be the first and main instrument to prevent them.

The researchers think that, these incidents may be due to that, neonates receive an excess number of medications and expose to many invasive procedures for diagnosis and treatment over a prolonged time, as well as, incidents can due to less equipment, devices failure, poor team communication, lack of nurses' education and training. In this regards **El-Meneza et al., (2019)** <sup>(24)</sup> mentioned that, the most adverse event types were due to equipment/device failure and added, the most errors contributing factors were due to poor education/training, and communication problems.

The researchers suggest that, application of voluntary, non-punitive incident report including both adverse events and medical errors within NICUs generates more and valuable data about type, causes and ways of prevention.

Regarding nurses' knowledge scores about safety measures in NICUs on pre- program intervention, finding of this study showed that, the nurses' mean score was low in relation to all safety measures. These agreed with **Elsayed et al., (2013)** <sup>(11)</sup> who found that, before the educational program application at NICU the total scores of nurses' knowledge was poor. This study finding can attribute the inadequate nurses' knowledge due to deficiency of the orientation program, deficiency of the nurses training program about safety guidelines within NICU, low level of nurses' education and absence of unified policy. This attribution confirmed by **WHO (2009)** <sup>(25)</sup> which stated that there was lack of nurses' knowledge and practice and attributed this problem to more reasons, such as lack of orientation program, less number of the nursing conferences and lack of supervisors' competency.

Moreover, our study showed significant improvement of nurses' total knowledge mean score about safety measures in NICU post program intervention. This finding was due to the effect of training and guidelines application which provided by the researchers. This finding consistent with **Rahimi, et al., (2018)** <sup>(26)</sup> who study the impact of training on nurses' performance, and stated that, the study not only showed positive impact of training on nurses,

but also, validates scope of continuing nursing education. In this regard **Kelly et al., (2011)** <sup>(27)</sup> mentioned that, providing more chances for nurses to pursue extra education could improve their performance level. Meantime, the nurses are capable of applied theoretical knowledge to clinical practice which lead to improving the quality of patient care globally

From study results the researchers suggested that, to eliminate the risk of incidents, the neonatal nurses should expose to the periodical training programs, including updating safety guidelines at NICU, which help them to apply care properly and effectively with minimal errors. Thus, assessing contributory factors, and implementing preventive measures can be helped in reducing these errors.

In this context **Amiri et al., (2018)** <sup>(6)</sup> mentioned that it is important to train nurses and supervisors frequently in the hospital to improve the general patient safety culture and implement additional actions necessary such as reported incidents and added that, lack of trained staff can lead to unsafe care.

### Conclusion

According to study findings, it can be concluded that a weak positive safety attitude in most areas of SAQ especially in relation to job satisfaction and stress recognition was perceived by the studied nurses team. The most incidents reported by the nurses were invasive procedures and respiratory care malpractices which lead to minor problems. while some errors consider serious and needed intensive care. Additionally, the findings can point to that, educational guidelines were effective for improving nurses' knowledge regarding to safety measures at neonatal intensive care unit. As well, this study indicated that hospitals need to assess patient safety status and climate frequently and promote health team communication system.

### Implications for clinical practices

1. Team management and the effective channel of communication with nurses must be improved.
2. Nurses should follow the national neonatal safety care guidelines to eliminate medical errors.
3. The nurses should apply the incidents reporting systems which consider as the key

of incident monitoring and the progress of medical error recurrence prevention.

4. It is necessary to train nurses and supervisors working in the NICUs about patient safety competency.

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