

Assessment of Nurses' Knowledge and Practices Regarding the Application of Safety Standard Precautions in Pediatric Critical Care

Randa Mohamed Adly¹, Safaa Salah Ismail², Saleh Mohamed Ahmed Saleh³

¹Professor of Pediatric Nursing, Faculty of Nursing - Ain Shams University

²Professor of Pediatric Nursing, Faculty of Nursing - Helwan University

³Quality Specialist at Arab Contractors Medical Center, Egypt

*E.mail of the corresponding author: saleh112067@bue.edu.eg

Abstract: Nursing staff has an important role in understanding and applying the safety standard precautions goals for children safety to minimized hazards and errors. Aim of the study: This study aimed to nurses' knowledge and practices regarding the application of safety standard precautions in hospitalized children. Research Design: A descriptive design used to conduct this study. Setting: It was conducted at medical and surgical pediatric critical care units at Children's Hospital affiliated to Ain Shams University Hospitals. Subjects: A purposive sample composed of 56 nurses regardless their experiences, level of education, position, or age. Tools of data collection: Tool [I]: A Structured Interviewing Questionnaire Sheet: This tool designed by the researcher to gather nurses' knowledge about the six goals of safety standard precautions in pediatric critical care units. Tool [II]: Observational Checklist: This tool designed by the researcher to assess nurses' practice about applying the six goals of safety standard precautions in pediatric critical care units. Results: There was statistical significant difference between qualification and years of experience of the studied nurses with their knowledge and practices regarding the application of safety standard precautions goals. Conclusion: In the light of the study findings, it concluded that, two third of the studied nurses had unsatisfactory knowledge and more than half of them had incompetent practices regarding the application of safety standard precautions in pediatric critical care units. Recommendation: Providing training programs for newly employed pediatric nurses about safety standard precautions and at regular intervals. Emphasize on the important for nurses' improvement of application of the safety standard precautions in pediatric critical care. Continuous evaluation for the application of safety standard precautions for pediatric patients in pediatric critical care.

Keywords: Safety Standard Precautions Goals, Patient Safety, Pediatric Patient Safety, International Patient Safety Goals, Pediatric Critical Care.

1. INTRODUCTION

Patient safety is a key component of hospital performance and improving critical care staff nurses' performance. Every organization strives to achieve this goal, as well as, providing high quality and potential errors are minimized (World Health Organization [WHO], 2016 and Vaismoradi, 2017).

Critical care settings provide lifesaving care for the critically ill patients. It is associated with significant risks for adverse events and serious errors with multiple interactions occurring between multidisciplinary health care providers, patients, and medical devices with increasingly complex interface (Bouldin et al., 2016 and WHO, 2018).

Safety Standard Precautions are standards developed by Joint Commission International (JCI) to promote specific improvement in patient child safety. Joint Commission International has developed International Patient Safety Goals (IPSGs), which were adapted from the joint commission national patient safety goals (Mady, El-Rafy & Tantawi, 2017 and Abousallah, 2018). The goals highlight problematic areas in health care and describe evidence and expert based

consensus solution to these problems, the goals are structured in the manner as standards including goal statement and measurable elements for each goal (**Joint Commission International Joint Commission Resources [JCI], 2017**).

Pediatric patient safety is one of the nations' most pressing health care challenges. Many pediatric patients die in hospitals each year as the result of lapses in patient safety (**Khaled, Yones & Wafik, 2017**). Therefore, safety for pediatric patients is important issue in global health care organization, pediatric patient safeties have become an international priority with major hospital programs being carried out in the United States of America (USA), United Canadian (UC) and many Arab countries such as Kingdom of Saudi Arabia and United Arab Emirates (**Mady, El-Rafy & Tantawi, 2017**).

Nursing surveillance is the key to patient safety as nurses can prevent iatrogenic harm and protect patients in critical care units from medical errors done by others. The role of pediatric critical care nurses in pediatric patient safety is influenced by the specific requirements of the specialty which need continuous, close monitoring of the patient, dynamic data analysis, anticipation of complications, complex decision making, continuous evaluation of interventions, and emotional support of the patient and family (**Chinn & Kramer, 2017**).

Pediatric professional nurses are using multiple methods to improve pediatric patient safety and quality care outcomes. The most component of pediatric patient safety are six goals; improving pediatric patient identification, improving effective communication, improving safety of medication (High-Alert Medication), ensuring safety operations and procedures, ensuring infection control measures and reducing the risk of pediatric patient falls. Pediatric nursing staff has an important role in understanding and applying the six international goals for pediatric patients in pediatric hospitals to minimized hazards and errors (**JCI, 2017**).

Implementation of safety standard precautions in pediatric hospitals especially in critical care settings can reduce medical errors and patient harm. Therefore, pediatric nurse's knowledge and practices is crucial and important step to improve child patient's quality of care.

Significance

The occurrence of adverse health events is an indicator of compromised patient safety. Globally, the reported incidence of adverse health events ranges between 4% and 17%. Interestingly, it was found that around 50% of all reported adverse events which compromised patient safety are preventable (**Killam et al., 2017**). Nurses' formal educational preparation is reported to be a causal factor of adverse patient events made by around 50% of new nurses with less than one year of experience (**Saintsing, Gibson & Pennington, 2016**).

Nursing practices errors could occur at any stage of the care process. Nearly all patients in critical care units will be affected by a potentially life-threatening error at some point during their stay. Medication errors account for 78% of the serious errors in critical care units in addition to accidental patients fall are among the most common adverse events reported in hospitals, complicating approximately 2% of hospital stays (**Cho et al., 2016**).

The World Health Organization (WHO) estimated that 7 of every 100 hospitalized patients in developed countries and 10 of 100 in developing countries will acquire at least one health care-associated infection during their hospital stay. In high-income countries, approximately 30% of patients in critical care units are affected by at least one health care-associated infection. This percentage is doubled or even tripled among ICU patient in low- and middle-income countries (**WHO, 2016 and Aziz & Safina, 2016**).

The risk of patient harm is especially significant in critical care units. However, a huge number of immune compromised patients are admitted to critical care units. Approximately 30% of critical care patients are affected by one or more episodes of harmful events (**WHO, 2016**). Among those are pediatric patients, particularly those who have blood dyscrasias such as leukemia and lymphoma, which require aggressive management through diagnostic and therapeutic treatment modalities such as chemo or radiotherapy. These patients are faced with increased risks of harm, and so life-threatening conditions (**Milligan, 2018**).

In an attempt to evaluate the prevalence of nosocomial infections in 27 hospitals in the Mediterranean region, studies at some countries including Egypt, Jordan, Lebanon, Morocco, and Tunisia revealed that its prevalence was 10.5%; among young adults as compared to 11.3% among pediatrics. Therefore, pediatric nurses have a professional and moral obligation to protect the health of their patients and share the responsibility to sustain and protect the natural environment (**Aziz & Safina, 2016**).

All standards of care provide a guide to the knowledge, skills, judgment and attitudes that are needed to practice safely. They describe what each nurse is accountable and responsible for practice, however the aim of safety standard precautions is to prevent harm (JCI, 2017). This harm may include the most common medical errors such as medication errors, bad communication, infection, falls, treatment errors and surgical errors may be preventable by healthcare professionals (Milligan, 2018). Therefore, it is important to assess the level of nurses' knowledge and practices regarding the application of safety standard precautions in pediatric critical care.

Aim of the Study

This study aimed to assess nurses' knowledge and practices regarding the application of safety standard precautions in pediatric critical care units through the following:

- 1) Assess nurses' knowledge regarding the application of safety standard precautions in pediatric critical care units.
- 2) Assess nurses' practices regarding the application of safety standard precautions in pediatric critical care units.

Research Questions

The following two research questions were formulated to achieve the aim of the current study:

- 1) What are the levels of nurses' knowledge regarding the application of safety standard precautions in pediatric critical care units?
- 2) What are the levels of nurses' practices regarding the application of safety standard precautions in pediatric critical care units?

2. SUBJECT AND METHODS

The subject and methods of the study are portrayed under the four main designs as the following:

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

I- Technical Design:

The technical design included study design, setting, subject and tools of data collection.

A) Study Design: A descriptive design was used to conduct the study.

B) Study Settings:

The study was conducted at medical and surgical pediatric critical care units at Children's Hospital affiliated to Ain Shams University Hospitals. This research setting is selected because it has more than one pediatric critical care unit as well as, it contains the most recent medical devices. The pediatric critical care units at Children's Hospital located at two separate building. The units in the old building located on the second floor which divided into two parts (Medical and Surgical Units) and each room have 8 beds. The units in the new building located on the third floor which divided into 3 units 2 Medical Units each unit have 6 beds and 1 unit for isolations which have 3 beds.

C) Study Subject:

A purposive sample composed of 56 nurses working at the previously mentioned settings (24 from the old building and 32 from the new building) regardless their experiences, level of education, position, or age were included in the study where data were gathered over six months period.

Exclusion criteria:

- 1) Nurses in the orientation program.
- 2) Nurses during internship period.

D) Tools of data collection:

Two tools were used as the following:

Tool (I): A Structured Interview Questionnaire Sheet:

This tool was developed and adapted by the researcher from International Patient Safety Goals (IPSGs) tool based on scientific literature review to assess nurses' knowledge regarding the application of safety standard precautions in pediatric critical care (JCI, 2017). This questionnaire was guided by three references which are policies and procedures of Children's Hospital, 2019, patient safety standards of the Joint Commission International, 2017 and standards of patient safety at Children's Hospital, 2019. It was written in simple Arabic language to suit nurses' level of understanding to gather data in relation to the following parts:

Part I:

It was concerned with Socio-demographic characteristics of the studied nurses: such as gender, age, marital Status, qualification, years of experience and job title

Part II:

It was concerned with Nurses' Knowledge: This part was concerned with assessment of nurses' knowledge regarding the application of safety standard precautions in pediatric critical care using safety standard precautions goals. It was categorized under 6 main goals with 70 question which divided to 12 questions for improving pediatric patient identification, 12 questions for improving effective communication, 12 questions for improving safety of medication (High-Alert Medication), 10 questions for ensuring safety operations and procedures, 14 question for ensuring infection control measures, and 10 question for reducing the risk of pediatric patient falls.

Scoring system:

According to study subjects' answers for each question, a correct response was scored one degree and incorrect was scored zero. The total score for the tool was 100 grade were allocated to all items of the questionnaire. Then the answers were checked with a key answer. These scores were summed-up converted into a percent score. Accordingly the studied nurses' knowledge was categorized into two levels: Score < 75 considered as unsatisfactory level of knowledge and Score ≥ 75 considered as satisfactory level of knowledge.

Tool (II): Nurses' Practices Observational Checklist:

It was adapted by the researcher and guided by three references which are, policies and procedures of children's hospital, 2019, standard of the Joint Commission International, (international patient safety goals) JCI, 2017, standards of patient safety at children's hospital, 2019 and then validated (JCI, 2017). This checklist was used to assess nurses' practice level regarding the application of safety standard precautions in pediatric critical care units. It was categorized under 6 main goals with 54 step which divided to 8 steps for improving pediatric patient identification, 14 questions for Improving effective communication, 8 questions for improving safety of medication (High-Alert Medication), 4 questions for ensuring safety operations and procedures, 8 question for ensuring infection control measures, and 12 question for reducing the risk of pediatric patient falls.

Scoring system:

For the applied step, it was scored one grade for done completely and correctly and that not done incompletely or incorrectly correct was scored zero for each step of practice. The scores of the items of each part were summed-up accordingly, these scores were converted into a percent score for total score. Score < 85 considered as incompetent practices and score ≥ 85 considered as competent practices.

II- Operational Design:

The operational design for this study consisted of four phases; preparatory phase, content validity, pilot study and field work.

A) Preparatory phase:

This phase included reviewing of literature related to children safety standard precautions using text books, articles, magazines and internet periodicals at the local and international levels. This served to develop the study tools for data collection. During this phase, the researcher also visited the selected places to get acquainted with the personnel and the

study settings. Development of the tools was done accomplished under supervisors' guidance and experts' opinions were considered.

B) Content Validity and Reliability:

The content validity of the study tools was tested through a panel of five professors from Faculty of Nursing, one from Helwan University, two from Ain Shams University and two from Faculty of Nursing, Cairo University to ensure its applicability and understanding, accuracy, clarity and comprehensiveness.

Reliability was tested by using a Cronbach's Alpha of (85%) for studied nurses' knowledge regarding safety standard precautions goals and (82%) reliable for nursing practices regarding safety standard precautions goals.

Reliability examined after the pilot study. Their opinion was elicited regarding the format, layout, consistency and relevancy of the tools and the necessary modifications were done accordingly.

C) Pilot study:

It was carried out on 10% (6) of nurses working at Children's Hospital (Medical and Surgical) Pediatric Critical Care Unit affiliated to Ain Shams University Hospitals in order to test the applicability of the constructed tools and the clarity, efficiency feasibility, objectivity of the included questions related to nurse's knowledge and practices toward children safety standard precautions and then the necessary modifications of the tools were done according to the results of pilot study. The pilot has also served to estimate the time needed for each subject to fill in the questions. According to the results of the pilot, some corrections and omissions of items were performed as needed. The pilot participants were included in the main study sample because no radical modification was done after conducting pilot study.

D) Field work:

To carry out the study, an approval was obtained from Ain Shams children hospital (Medical and Surgical Pediatric Critical Care Units) affiliated to Ain Shams University Hospitals. A letter was issued to them from the Faculty of Nursing, Ain-Shams University, explaining the aim of the study in order to obtain their permission and cooperation. Data were collected during a six months period from the first of June to the end of April (2020). The researcher was available two days per week, during the morning and night shifts to collect data. The questionnaire sheet was filled by the nurses in 20 minutes and the researcher observed nurses' performance using observational checklist as well as there were some steps reviewed from the pediatric patient file. In addition, there were steps which applied complete and correct and steps which applied incomplete correctly and incorrect.

Ethical considerations:

The research approval was obtained from the faculty ethical committee (Scientific Research Ethical Committee of the Faculty of Nursing, Helwan University) before starting the study. The researcher was clarifying the objectives and aim of the study to each nurse included in the study before starting, a written approval was obtained from the nurse before inclusion in the study, the researcher assured maintaining anonymity and confidentiality of subjects' data included in the study that it would be used for the research purpose only. The pediatric nurses informed that they are allowed to choose to participate or not in the study and they have the right to withdraw from the study at any time without giving any reasons.

III- Administrative Design:

Administrative approval obtained to carry out the study through an issued letter from the Dean of the Faculty of Nursing, Helwan University to directors of the previously mentioned settings explaining the aim of the study in order to obtain their permission and cooperation. An official permission to conduct the study obtained from the medical and nursing directors of Children's Hospital. The researcher then met the hospital director and explained the aim of the study, its expected outcome and the methods of the data collection.

IV- Statistical Design:

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

3. RESULTS

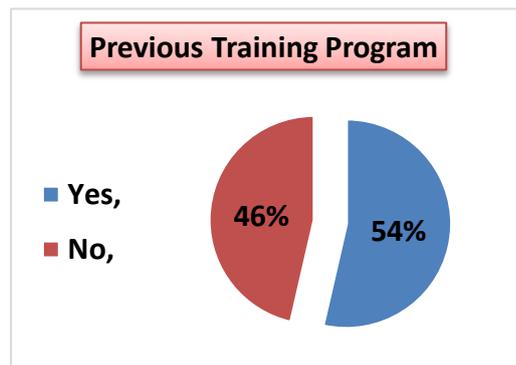
Part (I): Socio-Demographic Characteristics of Studied Nurses

Table (1): Distribution of the Studied Nurses According to their Socio-Demographic Characteristics. (No=56)

Socio-Demographic Characteristics	Frequency (N=56)	Percent 100%
Gender		
Female	34	60.7
Male	22	39.3
Age		
Less than 20	6	10.7
20 : less than 30	38	67.9
30 : less than 40	12	21.4
More than 40	0	0.0
Marital Status		
Single	41	73.2
Married	13	23.2
Divorced	2	3.6
Qualification		
Diploma in nursing / Technical institute	33	58.9
Bachelor in nursing	18	32.1
Master in nursing	5	8.9
Years of Experience		
Less than one years	22	39.3
1 : less than 5 years	25	44.6
5 : less than 10 years	9	16.1
More than 10 years	0	0.0
Job Title		
Staff Nurses	44	78.6
In charge nurse	8	14.3
Supervisor / Head nurse	4	7.1

Table (1) presents socio-demographic characteristics of the studied nurses. It clarifies that more than half of the studied nurses were females and more than two thirds were in the age group of 20 to less than 30 years. In addition, they were single (males & females) and had diploma in nursing/technical institute. Moreover, nearly half of them had one to less than five years of experience and work as staff nurses in percentages of (60.7 %, & 67.9 %, 73.2 %, 58.9 %, 44.6 %, 78.6 %) respectively.

Figure (1): Distribution of the Studied Nurses According to their Previous Training Program. (No=56)



Regarding attendance of training courses program figure (1) shows that less than half of the studied nurses (46 %) did not attend any training program about safety standard precautions. Also, it was found that all of the studied nurses mentioned about the availability of hospital guidelines for patient safety in their study settings.

Part (II): Nurses' Knowledge about the Application of Safety Standard Precautions in Pediatric Critical Care

Figure (2): Distribution of the Studied Nurses as Regards to their Subtotal Knowledge Scores Regarding Safety Standard Precautions Goals. (No=56)

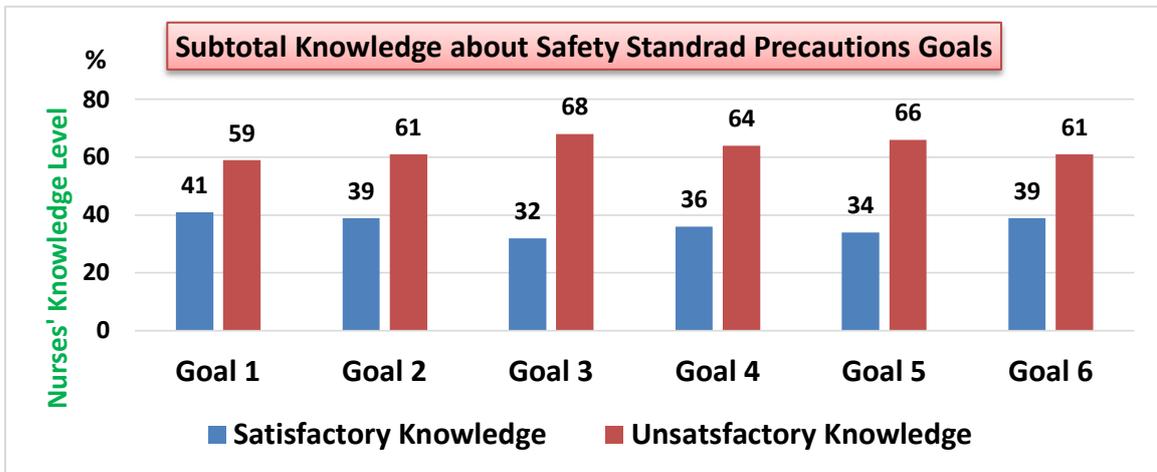


Figure (2) shows percentage distribution of the studied nurses as regards to their subtotal knowledge scores regarding safety standard precautions goals in pediatric critical care. It clarifies that, the studied nurses had unsatisfactory knowledge level regarding to Goal (1) improving pediatric patient identification, Goal (2) improving effective communication, Goal (3) improving safety of medication (High-Alert Medication), Goal (4) ensuring safety operations and procedures, Goal (5) ensuring infection control measures and Goal (6) reducing the risk of pediatric patient falls (59%, 61%, 68%, 64%, 66% and 61%), respectively.

Figure (3): Distribution of the Studied Nurses According their Total Knowledge Level Regarding Safety Standard Precautions. (No=56)

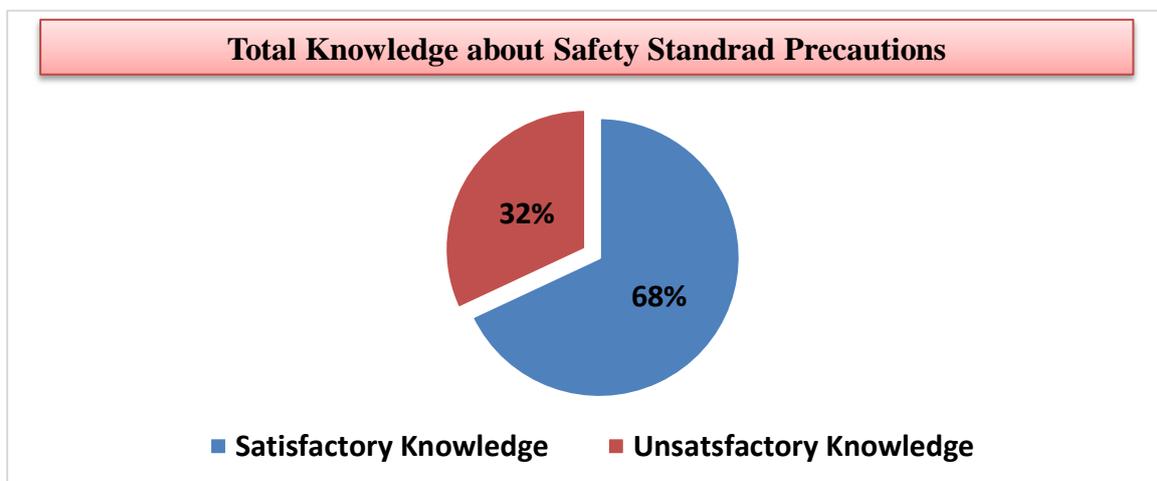


Figure (3) shows the distribution of the studied nurses according their total knowledge level regarding safety standard precautions. It clarifies that, two third of the studied nurses (68%) had unsatisfactory knowledge while nearly one third (32%) of them had satisfactory knowledge regarding safety standard precautions in pediatric critical care.

Figure (4): Distribution of the Studied Nurses as Regards to their Subtotal Practices Scores Regarding Safety Standard Precautions Goals. (No=56)

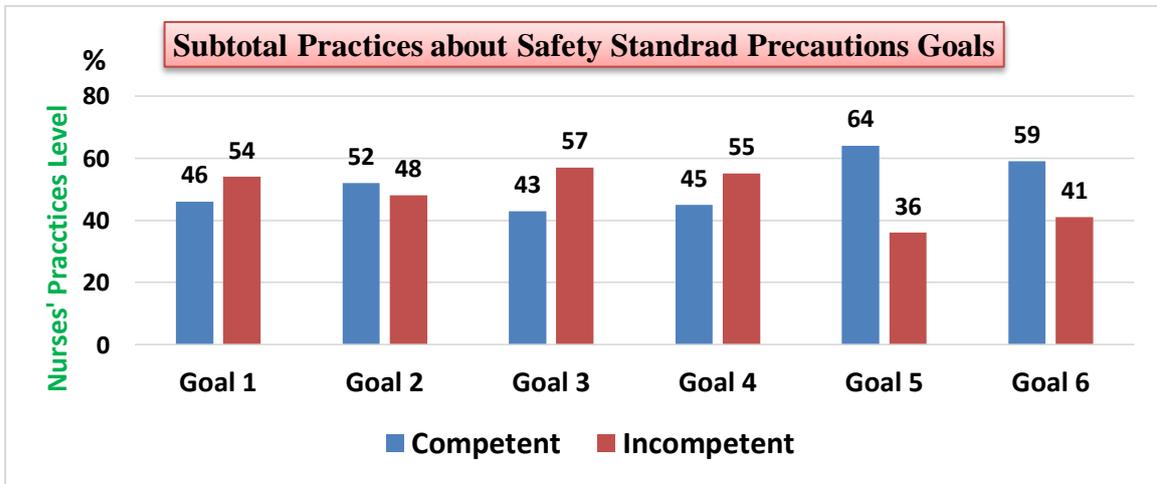


Figure (4) shows percentage distribution of the studied nurses as regards to their subtotal practices scores regarding safety standard precautions goals in pediatric critical care. It clarifies that, the studied nurses had incompetent practices level regarding to Goal (1) improving pediatric patient identification, Goal (2) improving effective communication, Goal (3) improving safety of medication (High-Alert Medication), Goal (4) ensuring safety operations and procedures, Goal (5) ensuring infection control measures and Goal (6) reducing the risk of pediatric patient falls (54%, 48%, 57%, 55%, 36% and 41%), respectively.

Figure (5): Distribution of the Studied Nurses According their Total Practices Level Regarding Safety Standard Precautions. (No=56)

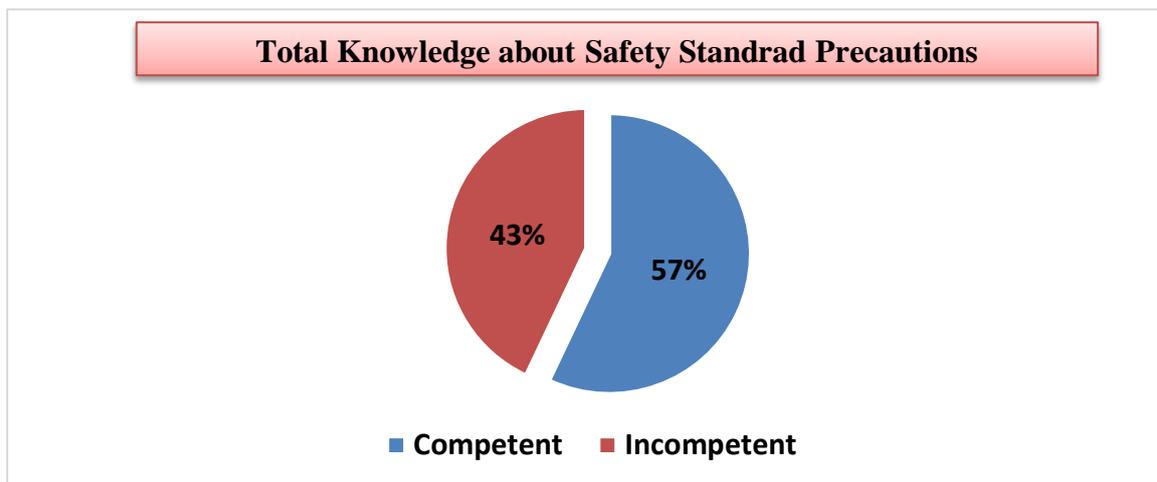


Figure (5) shows the distribution of the studied nurses according their total knowledge level regarding safety standard precautions. It clarifies that, more than half of the studied nurses (57%) had incompetent practices while nearly less than half (43%) of them had competent practices regarding safety standard precautions in pediatric critical care.

Part (IV): Relation and correlation between the study Variables

Table (2): Relation between Socio-Demographic Characteristics of the Studied Nurses and their Knowledge Regarding the Application of Safety Standard Precautions in Pediatric Critical Care. (No=56)

Socio-Demographic Characteristics	Total Knowledge				X ²	P-Value
	Satisfactory N = 18		Unsatisfactory N = 38			
	No	%	No	%		
Gender						
Female	12	21%	16	29%	6	0.4
Male	6	11%	22	39%		
Age						
Less than 20	2	4%	4	7%	11	0.03*
20 : less than 30	9	16%	29	52%		
30 : less than 40	7	13%	5	9%		
Marital Status						
Single	13	23%	28	50%	13	0.03*
Married	5	9%	8	14%		
Others	0	0%	2	4%		
Qualification						
Diploma in nursing / Technical institute	3	5%	30	54%	25	0.001**
Bachelor in nursing	11	20%	7	13%		
Master in nursing	4	7%	1	2%		
Years of Experience						
Less than one year	2	4%	20	36%	27	0.001**
1 : less than 5 years	14	25%	11	20%		
5 : less than 10 years	2	4%	7	13%		
Job Title						
Staff Nurses	8	14%	36	64%	23	0.001**
In charge nurse	7	13%	1	2%		
Supervisor / Head nurse	3	5%	1	2%		

*Significant at p < 0.05

**Highly Significant at p < 0.01

All parameters are represented as frequency (No.) and percent (%)

Table (2) demonstrated that, there was highly statistically significant relation between total knowledge of the studied nurses about safety standard precautions and their qualification, years of experience and job title (P < 0.01) and (X²=25 & X²=27 and X²=23). Also, there were statistically significant relation with their age and marital status (P < 0.05) and (X²=11 and X²=11). While, there was no significant relation with their gender (P > 0.05) and (X²=623), respectively.

Table (3): Relation between Socio-Demographic Characteristics of the Studied Nurses and their Practices Regarding the Application of Safety Standard Precautions in Pediatric Critical Care. (No=56)

Socio-Demographic Characteristics	Total Practice				X ²	P-Value
	Competent N = 24		Incompetent N = 32			
	No	%	No	%		
Gender						
Female	18	32%	16	29%	5	0.4
Male	6	11%	16	29%		
Age						
Less than 20	2	4%	4	7%	11	0.03*
20 : less than 30	17	30%	21	38%		
30 : less than 40	5	9%	7	13%		

Marital Status						
Single	18	32%	23	41%	6	0.4
Married	5	9%	8	14%		
Others	1	2%	1	2%		
Qualification						
Diploma in nursing / Technical institute	7	13%	26	46%	23	0.001**
Bachelor in nursing	13	23%	5	9%		
Master in nursing	4	7%	1	2%		
Years of Experience						
Less than one year	3	5%	19	34%	26	0.001**
1 : less than 5 years	16	29%	9	16%		
5 : less than 10 years	5	9%	4	7%		
Job Title						
Staff Nurses	14	25%	30	54%	12	0.03*
In charge nurse	7	13%	1	2%		
Supervisor / Head nurse	3	5	1	2%		

*Significant at $p < 0.05$

**Highly Significant at $p < 0.01$

All parameters are represented as frequency (No.) and percent (%)

Table (3) demonstrated that, there was highly statistically significant relation between total practice of the studied nurses about safety standard precautions and their qualification and years of experience ($P < 0.01$) and ($X^2=23$ and $X^2=26$). Also, there were statistically significant relation with their age and job title ($P < 0.05$) and ($X^2=11$ and $X^2=12$). While, there was no significant relation with their gender and marital status ($P > 0.05$) and ($X^2=5$ and $X^2=6$), respectively.

4. DISCUSSION

The patient safety culture is important in terms of representation of quality healthcare services. It involves all measure and precautions made for reduction or elimination of possible adverse effects of medical care during medical diagnosis and treatment. Patients' safety for hospitalized children is a key aspect in determining healthcare organizations' ability to address and reduce risks in pediatric care settings. The most frequent problems threatening the child safety are patient misidentification, ineffective communication, medication errors, complications during and after the operation, hospital infections and falls (Ozata & Altunkan, 2016).

Nurses working at pediatric critical care units have a crucial role in the establishment of a safe and qualified care for the patients. Critical care nurses are the personnel who give constant care, apply complicated medications, use various technological equipment and offer care to patients in need of advanced life support (Ozata & Altunkan, 2016).

Pediatric nurses play a major role in children's safety because they are accountable for direct and continuous child care. For this reason, it is of great significance for the pediatric nurses to adopt, defend, and have a critical perspective on the issue of patient safety to offer a prolonged and safe care. It is required to determine primarily the safety standard precautions in the hospital / institution in order to enhance the patient safety culture and prevent deficiencies, practices or risk factors causing medical errors (Vidhan & Özer, 2015 and Mady, El-Rafy & Tantawi, 2017). So, the current study aimed to assess nurses' knowledge and practices regarding the application of safety standard precautions in pediatric critical care units.

Part (I): Socio-Demographic Characteristics of Studied Nurses:

Regarding the studied nurses socio-demographic characteristics, the results of the present study revealed that the majority of the study nurses were female. These findings were inconsistent with Hassanin (2016) who conduct a study entitled "Nurses performance regarding the neurological assessment in neurological unit" who stated that three quarter of the study subject were female. This may be due to the greater fraction of the nurses in Egypt was female and may also related to the studying of nursing in Egyptian universities were exclusive for females only till few years ago.

Regarding to the studied nurses' age, the present study show that almost two thirds of the studied nurses were ranging from 20 to less than 30 years. This finding was supported by Ibrahim (2015) who reported that the mean age of the

studied nurses was (32.32 ± 6.70) with age ranged 20-50 years. Concerning their qualifications, this findings showed that more than half of the study nurses were diploma/technical institute nurses, this study disagrees with **El-Gendi et al. (2017)** who conducted a study entitled "Assessment of Patient Safety Culture among Egyptian Healthcare Employees" and showed that all ICU nurses had a bachelor degree in nursing science.

As regards years of experience of the studied nurses, the study findings showed that more than one third of them have one to less than five years of experiences. This study disagrees with **Kandeel and Tantawy (2014)** entitled "Current Nursing Practice for Prevention of Ventilator Associated Pneumonia in ICUs" who reported that the largest percentage (40.7%) had between 6 and 10 years of ICU experience, and 34% had between 1 and 5 years of ICU experience. This explains that most of those nurses were newly graduated, young and tolerate the nature of the work. This result is in agreement with **Said (2015)** who investigated the knowledge and practice of intensive care nurses on prevention of ventilator associated pneumonia at Muhimbili national hospital and found that more than two thirds were working in ICU for less than 10 years.

Regarding studied nurses' attendance of training program the study findings showed that nearly half of them attend hospital training program regarding patient child safety, however, this not reflected on their performance. This finding were contraindicate with **Aboul-Fotouh et al. (2016)** who carried out a study about "Assessment of patient safety culture among healthcare providers at a teaching hospital in Cairo" and found that, less than three quarters didn't receive training course. This may be due to lack of continues education regarding safety standards precautions in their workplace.

Part (II): Nurses' Knowledge about the Application of Safety Standard Precautions in Pediatric Critical Care:

Regarding to nurses' knowledge about improving pediatric patient identification, the present findings showed that, more than half of nurses have incorrect knowledge regarding to methods of pediatric patient identification, number of identification (two patient identifier), identification of neonatal patient, steps of identification of conscious pediatric patient and identification of unconscious pediatric patient, respectively.

The current study findings were in agreement with the findings of **Abu Mostafa et al. (2019)** who conducted a study bout assessing knowledge level of patients' identification at a specialized pediatric hospital in Saudi Arabia. It was revealed that, the majority of healthcare providers (87.1%) and almost half of non-healthcare providers (47.8%) reported high levels of knowledge of patient identification standards, including the need to use two patient identifiers. In addition, the study results highlight the need for further attention to improper identification of patients in critical care settings.

This study was in accordance with the study of **Khater, Mahasneh and Akhu-zaheya (2015)** who studied nurses' perceptions of patient safety culture in Jordanian hospitals particularly from the perspective of healthcare providers and it was mentioned that, most of the studied nurses have incorrect perception regarding the identification of patients. In this regard, the researcher could see that, patients' misidentification remains a critical issue in health care particularly for nursing staff. Being knowledgeable about how to accurately identify patients and comply with identification processes is critical, especially in countries where patients have similar names.

Regarding to nurses' knowledge about improving effective communication, the present study showed that less than two thirds of the studied nurses have incorrect knowledge regarding uses of verbal/telephonic orders, steps of receiving verbal/telephonic orders, emergency situations for verbal/telephonic order, duration to confirm verbal/telephonic orders by the authorized person, authorized person who give verbal/telephonic orders, cases not allowed for verbal/telephonic orders and data included in handover between pediatric nurses staff, respectively.

The present finding supported with a study conducted by **Donchin et al. (2015)** to assess the nature and causes of human errors in the intensive care unit, the study showed that effective communication between medical team especially nursing reduce mistakes in handover and provide patient safety in details of patient data. Additionally, the current study finding was in agreement with the finding of **Moghri et al. (2012)** who study validation of farsi version of hospital survey on patient safety culture questionnaire, using confirmatory factor analysis method, mentioned that most of the studied sample identified incorrect answers regarding interpersonal communication in patient safety.

The researcher attribute the present results due to lack of communication courses and work loading. It will lead to developing failure of contingency plans in the event of potential complications.

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In relation to nurses' knowledge about improving safety of medication (High-Alert medication), it was found that two third of the studied nurses have incorrect answer regarding criteria of high alert medication, precaution while using high alert medication, labeling of high alert medication, labeling of look-alike medication, labeling of sound-alike medication and handling high alert medication, respectively.

The study results were in agreement with **Fathy and Kabeel (2016)** who studied nurses' points of view for medication administration errors regarding patient safety at children's university hospitals. It was reported that medication administration errors result from interrelated factors, concerning the types of errors occurred when the medication is delivered by the wrong route, changing of medication, frequency of medication, wrong drugs, wrong dose, wrong patient and wrong time. However, wrong date and wrong documentation were the least frequent among the studied nurses.

This study was in accordance with **Abusaad and Etawy (2015)** who studied medication administration errors at children's university hospitals: nurses' point of view. As regard causes of medication error, the results of this study indicated that more than half of studied nurses believed that multiple causes were involved in medication error. The three main causes that they stated to be involved were heavy workload, personal neglect and insufficient training.

The present study finding was highly supported by the study of **Sa'ed et al. (2019)** who assess the level of knowledge regarding High Alert Medication. The study showed that nurses with a master degree, those working in the ICU ward, head nurses, and male nurses were the most knowledgeable groups. However, the study mentioned that the leading obstacles were inconsistent opinions between doctors and nurses, and non-established standard operating procedure for HAMs.

In this regard, the researcher found that lack of knowledge was one of the obstacles that nurses encountered during administration of HAMs which might result in Medication Errors (MEs). Therefore, Nurses reported that they would like to have additional training to update their pharmacology knowledge and could benefit from additional training programs.

In this regard, the researcher found that the highest stages of medication errors was done by pediatric nurses as missing of medication, patients monitoring and medication administration. So that, the researcher recommends that reducing medication errors is an important part of ensuring patient safety in the pediatric population. The researcher sees that careful attention to the factors affecting medication safety is important which need more investigation.

Concerning to nurses' knowledge about ensuring safety operations and procedures, the present study findings indicated that nearly two third of the studied nurses have incorrect knowledge regarding aim of perioperative preparation, appropriate perioperative steps, handover pediatric patient to operating room, assigned person for site marking, aim of site marking and consideration of site marking, respectively.

This study was in accordance with Canadian study by **Golebiowska & Golebiowska, (2016)** who compared the ways of implementation of the surgical checklist / preoperative checklist among 15 children hospitals in Canada within the participation of the 3 sub-teams (anesthesia, surgery, nurse) within 12 months. The study concluded that there is no requirements set on who should be the leader of the checklist implementation. Also, the study showed that, errors were identified with usage of the checklist such as wrong patient, wrong patient side or wrong procedure, were prevented due to the checkup. In 87% of hospitals, the safety culture improved in the operating room.

In this regard, the researcher sees that in Egyptian hospitals there is no clear process for applying the surgical checklist / preoperative checklist and there is no policies in the MOH guarantee who should be the assigned person for site marking and preoperative checklist implementation.

Regarding to nurses' knowledge about ensuring infection control measures, nearly two third of the studied nurses have incorrect answer regarding types of hand hygiene, indications of hand washing, indications of wearing gloves, indications of wearing gown, indications of wearing masks, indications of wearing head cover, handling sharp objects, handling medical wastes and isolation precautions, respectively.

The present study findings was in contrary with **Escander, Morsy and Elfeky (2014)** who studied nurses' knowledge regarding infection control standard precautions at the intensive care unit of Children Cancer Hospital (57357) – Egypt. The study revealed that, approximately two thirds (63.6%) of the studied sample had unsatisfactory knowledge level (<75%).

The current study results inconsistency with **Asadollahi et al. (2015)** who carried a study entitled "Nurses' knowledge regarding hand hygiene and its individual and organizational predictors" and reported that the nurses' knowledge was appropriated in the field of nosocomial precautions particularly about methods of transferring infection and proper time for doing hand hygiene.

Based on the findings of the present study, the researcher see that the studied nurses had unsatisfactory knowledge level regarding infection control standard precautions and this might be due to less in continues education and absence of continuous supervision about infection control precaution.

Regarding to nurses' knowledge about reducing the risk of pediatric patient falls, nearly two third of the studied nurses have incorrect answer regarding assessment and reassessment of pediatric patient fall risk, precaution must be follow by pediatric nurses to decrees pediatric falling, action taken when falls happen and instructions for pediatric patients with high score of fall, , respectively.

The present study findings were in agreement with study results of **Lee et al, (2013)** about fall prevention among children in the presence of caregivers in pediatric wards. It was shown that about 56% of falls from bed in hospitals and 47% occur to patients aged 3 years and below. A study revealed that children aged 3 years and below is more susceptible to unanticipated falls in the hospital because of their unsteady gait and unfamiliar environment. The study also states that the presence of caregivers in the room does not prevent falls of children in the hospital. The researcher see that this is because caregivers tend to be distracted, less attentive and less vigilant in a new environment during their child's hospitalisation due to stress and anxiety. In addition, the study suggested that Inpatients falls are a nursing-sensitive quality indicator in many organisations.

Regarding to nurses' knowledge about the application of safety standard precautions, the findings illustrated that, most of the studied nurses did not know knowledge regarding improving pediatric patient identification, improving effective communication, improving safety of medication (High-Alert Medication), ensuring safety operations and procedures, ensuring infection control measures and reducing the risk of pediatric patient falls.

The present finding supported by **Eldeeb and Ghoneim (2016)** who conducted a study about perception of patient safety among nurses at Shebin El-Kom Teaching Hospital. It was mentioned that all healthcare professionals are susceptible to commit adverse events. It was mentioned that most of the nurses had poor knowledge regarding patients' safety at hospital, although, nurses are the key to safety improvements in many aspects.

Regarding total nurses' knowledge regarding to the application of safety standard precautions, the results of the current study indicated that two thirds of the study nurses had unsatisfactory knowledge regarding the application of safety standard precautions in pediatric critical care. It may due to lack of patient safety courses, although the majority of studied nurses had training courses that may be not updated and not continuous planned patient safety courses in additional to inactivation of in-service education department in Children Hospital. These results are agreed with **Yilmaz and Goris (2015)** who studied the determination of the patients' safety culture among nurses working at intensive care units and reported that (64.61%) had unsatisfactory knowledge about patient safety rules and regulation.

Also, this study consisted with **PSA (2015)** while it was found that the majority of incidents reported were related to pressure sores, infection control, patient miss identification, patient falling and medication error due to defect in nurses knowledge.

This study finding was supported by the study results of **Mady, El-Rafy and Tantawi (2017)** about assessment of the dimensional application of international safety goals for children in hospitals. The study findings concluded that, more than half of the studied nurses had poor knowledge regarding the levels of the dimensional application of international safety goals for children in hospital. Also, the study recommended that establishing the system of application the international safety goals for children in hospital and emphasize the important of application the international safety goals for children in hospital in nursing.

The researcher believes that, the innovation of different new concepts regarding patient safety and term the culture is more subjective and invisible than climate, therefore that the safety climate can be thought as the quantitative manifestation of the safety culture, which can be quantified with visible indicators like outcome (like the number of adverse events) or process indicators (like the rate of adherence to caring process guidelines).

Part (III): Nurses' practices about the Application of Safety Standard Precautions in Pediatric Critical Care:

The current study clarified that more than half of the studied nurses were did not apply improving pediatric patient identification regarding pediatric patients wearing ID wrist band, pediatric patients identified before providing treatments and procedures, making double checking before administrating blood/blood product, double checking during medication preparation charge nurse, all forms and paper in the medical file contains patient ID label and all medications dispensed with pediatric patient name and MRN not the room or bed, respectively. The current study results supported with **Oliveira, Kovner and Silva (2015)** who conducted a study entitled "Patient identification errors from failure to use or check ID numbers correctly" and reported that 98% of incident report related to missing of medical number on patient band.

This study was in accordance **Bernal et al. (2018)** who studies patient identification practices in a pediatric intensive care unit in three public hospitals in the South of Brazil. The study result showed that of the 96 patients observed, 94 (98%) had an identification nameplate next to the bed. No identification wristbands were used. The identification nameplates included the child's name (95%), age (31%) and the name of the person responsible (78%). Of those identified by name (n=89), 62 (70%) were complete. In the medical prescription and nursing record there were deficiencies in the registration of the full name, date of birth and names of the parents.

According to **Bernal et al. (2018)** who conducted a study aimed to identify potential risks to pediatric patients; it found that patient discharge was identified as the main failure, while parental complaints about the length of the hospitalization, delays in the diagnosis or treatment and unnecessary treatment were the most common effects. However, from the main causes of the risks, not including the family in the care process, change of shift and incorrect identification of the patient were also verified (**Bernal et al., 2018**).

From the researcher's points of view, the present study results illustrated that despite the wide range of resources, there was a deficiency in the systematization of patient identification, affecting unsafe care. Therefore, the researcher highlights the need for further attention to improper identification of patients including understanding the causes and ways to enhance the translation of patient identification standard into practice. In particular, patient identification can be reaffirmed as a primary and legitimate aspect of safe care.

The current findings illustrated that, nearly half of the studied nurses did not apply improving effective communication regarding verbal & telephone orders; verbal orders are documented, confirmation of verbal orders within 24 hours, complete verbal order and complete telephone order. Regarding to critical results reporting; documentation of critical results, confirmation of critical results by the physician, documentation of action taken after received critical results in pediatric patient's file, documentation of critical results in log book and availability of critical values' list in the unit. Regarding to handover between pediatric nurses; complete and correct nursing handover, correct nursing handover during pediatric patient transfer, complete and accurate nursing transfer forms and complete and accurate handover forms between units.

In this context it was mentioned by **Laurel, Despins and Aprn (2014)** that most immediate outcome of team training is improved team behaviors. While, effective team behaviors. While, result in greater patient safety through reduction of medical errors and better management of incident.

In relation to hand over between the pediatric nurses', the present study findings revealed that more than half of studied nurses do hand over at the end of shift but approximately three quarters did not notifying about errors or mistake that happen to patient care because of their worry about punishment that lead to patients' harm without identifying the causes and early solving. This result supported by **Spooner et al. (2016)** who reported that absence of hand over as blood results and medication orders that lead to errors by the incoming clinician there-by compromising patient care.

This study was in accordance with **Silva et al. (2016)** who studied communication in nursing shift handover: Pediatric patient safety at a pediatric inpatient unit of a University Hospital in the South of Brazil. The results emphasised the importance of shift handover, in which effective communication is essential for safe care. However, greater objectivity is needed in the information transmission, the time used needs to be reduced and the shift handover records need to be systemized. In this regard, the researcher sees that nursing inter-shift handover requires the use of a highly valuable and important standardized tool and data to ensure high quality of patient care.

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The researcher see that this may due to lack communication skills demonstrated in training program in addition to the majority of studied nurses have experience less than 5 years that may associated with effective communication , problem solving and provide model of successful nurse.

By assessing nurses ' practices regarding high alert medication safety it was found that, more than half of the studied nurses did not apply improving safety of medication (High-Alert medication) regarding availability of high-alert medications, storage of high-alert medication, separating of look-alike and sound-alike medications, proper labeling of high alert medications, proper labeling of dispensed high-alert medications, complete labeling of high-alert medications, double checking of high-alert medications and documentation of high-alert medication, respectively.

The current study finding agreed with **Mohamed (2014)** who stated in a study entitled: "Assessment of nurses knowledge and practice of high alert medication among critically ill patient" and reported, the majority of the studied subject have un satisfactory practices related to administration of high alert medication which observed through absence of preparing equipment, checking prescribed medication, monitoring volume of fluid infused at least every hour, monitoring patient vital signs during admiration of selected high alert medication in addition to monitoring for extravasation and electrolyte levels.

In relation to administration phase of selected high alert medication, the current study finding revealed more than half of the studied nurses have in correct practices regarding storage, proper labeling and documentation of high-alert medications. This finding is on the same line with **Calabres et al. (2015)** who conducted a study entitled for " Medication administration error in adult patient in ICU " and reported that despite grouping the targeted medication according to therapeutic classes, vasoactive drugs were involved in the highest number errors.

According to the study of **Abusaad and Etawy (2015)** who studied medication administration errors at children's university hospitals: nurses' point of view. The results indicated that nurses, physicians and pharmacists were involved in all stages of medication errors. However nurse was the most responsible person for occurrence of medication errors especially through missing of medication, patients monitoring and during administration of medication to child, followed by a physician who prescribe and order the medication and finally the pharmacist during medication transcribing and dispensing, this may results from availability of different preparation of the same drug combined with diverse formulation for pediatric administration were reported to increase the risk of error.

These results come in contrary with the results of **Keers et al. (2013)** while it was mentioned that physicians had been committed the most medication errors followed by pharmacists and then nurses.

The researcher sees that, this may due to over duties up on Egyptian nurses that can associated with errors. Also, it was found that several factors might attribute to the present findings such as inadequate knowledge about administration of high alert medication, inadequate number of staff nurses', work loud in addition to in adequate communication between nurses and physician and unavailable working of infusion pump in a good condition.

Concerning ensuring safety operations and procedures the findings of the present study indicated that more than half of the studied nurses did not apply complete and accurate booking request, complete and accurate preoperative checklist, proper site marking and proper handover to OR and cath. lab, respectively.

This study was in accordance with **Gołębiowska and Gołębiowska (2018)** who study "surgical safety checklist in pediatric surgery" mentioned that a Canadian study compared the ways of implementation of the surgical checklist among 15 children hospitals in Canada within 12 months. The errors were identified with usage of the checklist as well as wrong-surgery, wrong-procedure and wrong-patient surgery were prevented due to the checkup.

The researcher sees that at all stages of the process, there should be consistency of documentation of side / site. If any inconsistency arises, progress toward operations should be suspended, the incorrect documentation should be changed and signed, and an explanation of the inconsistency recorded in the patient's medical history and signed by the surgeon. The surgeon should satisfy himself / herself of the appropriate side / site of surgery and record this in the patient's medical notes before proceeding with surgery. Consequently, nurse's role is to identify the correct sit and sign on it also, the nurse should indorse the sit to OR circulating and scrubbing nurse. This role should be involving the doctors (Anesthesia or surgeon).

As regard ensuring infection control measures, it was clear from the current study that nearly one third of the studied nurses did not apply five moment for hand hygiene, proper hand washing practice technique, hand washing before medication preparation, hand washing before medication administration, wearing clean gloves before blood transfusion, wearing sterile gloves before wound care/dressing and wearing PPE for isolated pediatric patients, respectively.

The current study finding was in agreement with **Escander, Morsy and Elfeky (2014)** who study intensive care nurses' knowledge & practices regarding infection control standard precautions at the intensive care unit of children cancer hospital (57357). The study revealed that, approximately more than half of the studied sample had satisfactory performance level.

In this regard, the researcher found that this may be due to work loading, shortage of nursing staff, and many nurses have false concept about infection control that not necessary to procedures for critical patients.

The current study clarified that nearly half of the studied nurses did not apply assessment and reassessment of pediatric patient fall risk regarding Screening of pediatric patents for fall risk on admission, complete fall risk assessment within initial 24 hrs, reassessment of pediatric patients when needed and accurate documentation of fall risk assessment. Regarding application of Fall Risk Precautions for High Risk Pediatric Patient, nearly half of the studied nurses did not apply hanging the sign (F) on the door/bed of the pediatric patient, side rills working efficiency, availability of telephone and call bell near the pediatric patient, compliance with fall precautions during transfer, pediatric patient and family fall education and accurate fall risk documentation.

According to the study findings by **Margo and Patricia (2016)** the study entitled "Quigley Reducing Falls and Fall-Related Injuries in Acutely and Critically Ill Patients " it was reported that 20% of critical ill patient fall at least once daily, related to implementation of safer environments of care for the whole patient cohort (ie, flooring, lighting, and observation) and identification of modifiable fall risk factors as well as continues training program related to fall prevention for the health professional.

Children's falls are a safety concern. In-patients falls are a nursing-sensitive quality indicator in many organizations, such as Joint Commission and Magnet Recognition Program (**Lee et al., 2013**). The present study findings was highly supported by the study of **Chromá (2016)** who studied risk of falling in pediatric nursing and concluded that falls Injury can result either from human error or without fault on the part of medical staff. This consistence with **Spoelstra, Given and Given (2014)** who carried out a study entitled " Fall prevention in hospitals" and reported that 76% of patient had fall injured related to unavailable of safety strategies to reduce patient fall. The researcher sees that this may due to shortage of staff and absence of supervision. In addition, the researcher emphasises, it is necessary to identify the pediatric patients at risk of falling and preventing falls in nursing practice. Falls are a common area of pediatric nursing responsibility should be discussed.

Regarding total nurses' practice regarding the safety standard precautions, the results of the current study indicated that about more than half of the study nurses had incompetent practice regarding the application of safety standard precautions in pediatric critical care at Children hospital.

The current study findings disagree with **AL-Ishaq (2014)** who reported that 77% of nursing staff have positive and satisfactory practice regarding patient safety at Hamad Hospital that was illustrated by the researcher could be due to continues education and training effective in service education, good supervision and available of all facility and equipment which improve patient safety and job satisfaction.

This study finding was in-agreement with **Mady, El-Rafy and Tantawi (2017)** while it concluded that, more than half of the studied nurses had unsatisfactory practices regarding the levels of the dimensional application of international safety goals for children in hospital. In this regard, the researcher recommends that establishing the system of safety standard precautions for pediatric patients in hospital and emphasise on the important of its application.

Part (IV): Relation and correlation between the study variables

Regarding relation between Socio-demographic characteristics of the studied nurses' and the total knowledge regarding the application of safety standard precautions in pediatric critical care. The current study indicated that there was a high statistical significant difference between nurses' knowledge and their qualification, years of experience and job title, also moderate significant relation between nurses' knowledge and their age and marital status.

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The finding was in agreement with **Mady, El-Rafy and Tantawi (2017)** who studied assessment of the dimensional application of international safety goals for children in hospitals and reported that there is strong correlation between years of experiences, qualification regarding the application of safety standard precautions.

Regarding relation between Socio-demographic characteristics of the studied nurses' and the total practices regarding the application of safety standard precautions in pediatric critical care. The current study indicated that there was a high statistical significant difference between nurses' practices and their qualification and years of experience, also moderate significant relation between nurses' practices and their age and job title.

This finding is supported with **John et al. (2015)** study revealed that nurses with baccalaureate degree had slightly higher median practice score than diploma holders. The current study shows that moderate statistically significant relation between the nurses' practice and their gender, job level. This finding is in accordance with **Al-Youssif and Mohamed (2014)** illustrated that weak statistically significant correlation between participant's age and experience with practice.

Regarding training program, the current study shows that high statistical significant relation between nurses' knowledge and practices and training courses. This may be un-continuous courses to upgrade and refresh knowledge. This finding is agreed with **Hassan and Ahmed (2015)** who study Patient safety: assessing nurse's compliance and revealed that there were statistical significant correlation regarding attending programs and total scores of nurse's knowledge and compliance to patient safety.

5. CONCLUSION

In the light of the present study findings it was concluded that almost two third of the studied nurses had unsatisfactory level of knowledge and more than half of them had incompetent level of practices regarding the application of safety standard precautions in pediatric critical care.

Meanwhile, some factors observed might be contributed as obstacles for nurses' application of safety standards precautions in pediatric critical care units were observed included their qualifications, years of experiences and its relation with their level of knowledge and practices.

6. RECOMMENDATIONS

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

- Providing training programs for newly employed pediatric nurses about safety standard precautions and at regular intervals.
- Emphasize on the important for nurses' improvement of application of the safety standard precautions in pediatric critical care units.
- Continuous evaluation for the application of safety standard precautions for pediatric patients in pediatric critical care units.
- Strict observation of nurses' performance/utilization of safety standard precautions and correction of poor practices by the quality team are required.
- Availability of posters for pediatric nurses to comply with the application of safety standard precautions in pediatric critical care.
- Continues monitoring for factors predisposing to lack of compliance with application of safety standard precautions in pediatric critical care units.
- Future researches to be conducted to identify the barriers and obstacles for compliance of the application of safety standard precautions in pediatric nursing practices.
- Future studies to be conducted to application of safety standard precautions in larger areas of pediatric nursing aiming to generalization of the study findings.

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