

# Effect of Implemented Risk Management and Safety Measures Educational Interventions on Knowledge and Practice of Nursing Students in Clinical Setting

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**Abstract:** The safety of undergraduates nursing students today is a key for competent nurses to safe patients tomorrow. **Aim of the study:** The present study aimed to implement risk management and safety measures' educational intervention to safe students during their clinical training in the practice settings through improving knowledge and practice related all biomedical risks. **Design:** A quasi experimental design was applied. **Settings:** The study was conducted at the Faculty of Nursing and (Medical, General & Emergency Surgery and Oncology Departments) at Tanta University hospitals, Egypt. **Sample:** (144) students were exposed to the study, with response rate of 65.75% from the tool number of students (219) enrolled in 2<sup>nd</sup> year of Nursing Faculty. **Tools:** Three tools were used for data collection; Tool(I):"Risk Questionnaire Sheet" that consisted of "Socio-demographic Data", and "Risk Assessment Knowledge", to asses entitled Medical concepts, Types, Sources, and Levels of risks; Tool (II): "Safety Measures Questionnaire sheet" It was a structured questionnaire aimed to assess students' knowledge of safety measures. Tool (III): "Observed Clinical Performance Checklist" to observe students' clinical performance related to risk management and safety measures. **Results:** Students' total knowledge level was good (98.6%) and performance post training, the results proven that (10.4%) of students needed practice, (31.9%) satisfied practice and (57.7%) good practice with statistical significance differences ( $p=0.00$ ). **Conclusion:** The risk management and safety measures educational intervention achieved its expected outcome as demonstrated by 98.6 % of good level of total knowledge and good practice for around two third of the undergraduate nursing students on risk management and performance of safety measures post educational intervention. **Recommendation:** For the current research it was recommended to convert the intervention into a risk management systematic plan used for the safety of all undergraduates nursing students in their clinical practice settings. Moreover for further research, it was recommended that this designed educational intervention and /or future plan to be extend to others nursing faculties.

**Keywords:** risk management, safety measures, safety students, clinical settings.

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## 1. INTRODUCTION

One of the leading objectives of university education is to equip students with knowledge and skills that characterize each discipline and to qualify them for the professional world (Moreno –Arroyo Ma et al., 2016). Since nursing is a performance based profession, clinical learning environment play a vital role in gaining professional capabilities and push the nursing students to get into the nursing profession to become a qualified nurse (Jamshidi et al., 2016). Students are liable to suffer from psychophysical attrition due to the nursing faculty activities and the actuality of experiencing ergonomic, psychosocial and hospital risks at clinical training practice.

Injuries, illnesses, and incidents describe the failure to identify or recognize hazards are one of the "root causes" that present at workplace, or that could have been anticipated (**Occupational safety and health administration "OSHA" 2019**). Hazards defined by **Kalokairinou et al., (2011)** as an latent characteristics of a substance, agent, origin of energy or situation that has the potential of causing unwanted outcomes while risk is the probability that cause harm to human life, health, and or the environment' may occur from a hazard (**Abou EL – Enein and EL Mahdy, 2011**).

Also risk can be defined as the chance that someone will be harmed by the hazard. It also takes account of how severe the harm or ill health could be and how many people could be affected (**Health and Safety Authority, 2016**). The risk management is defined as the systematic process of identifying, evaluating and addressing potential and actual risk (**Kubheka, 2014**).

The students should know that all workplaces have hazards that can be identified and corrected. The definition of word "hazard:" as it is anything at work that can hurt individuals, either physically or mentally. Inform students that a simple way of looking at hazards is to divide hazards into four categories: Safety hazards; Chemical hazards; Biological hazards; and other health hazard (**National institute for occupational safety and health ;NIOSH, 2016**).

Occupational hazards categorized as biological and non-biological. Biological hazards involved wounds, cuts, sharp related injuries, direct contact with infected specimens/ bio-hazardous materials, blood borne disease, infectious diseases/infections, airborne diseases and pollution from soiled materials, whilst, the non-biological hazard involve physical/ ergonomic, chemical, and psychosocial hazards (**Bazeyo et al., 2015**).

The high incidence and burden of occupational hazards in hospitals include bloodborne disease such as hepatitis B and human immunodeficiency by being exposed to infectious sharp objects like needle stick injuries, scalpels, broken glass, extract blood samples, and connect or disconnect needles from patients (**Abdo et al., 2014 and Ahmed et al., 2015**).

Ergonomic injuries results from patient lifting or positioning, lifting heavy equipment, and static postures. Whilst, chemical hazards may result from patient treatment and maintenance of a proper environment in healthcare settings, Chemical hazards is unsafe and considered the most serious source of hazards, as it is difficult to identify its short and long term effect on the affected person. Chemical exposure can result from sterilants, cleaning compounds, hazardous drugs, disinfectants, mercury, anesthetic gases, latex etc (**Dropkin et al., 2013**).

Psychological hazards, is defined as passive self-perception, negative view on life in general, and shifts in mood such as; irritation with anything, loss of self-confidence, feeling of emptiness, loss of self- control, feeling of bitterness, feeling of defeat, crying for no visible reason, willingness to give everything up, long standing feeling of despair, passive image of self and difficulties to concentrate (**Burdorf and Ijzelenberg, 2014, Eljedi, 2015**). Furthermore, social hazards, is defined as a difficulties in family relationships and feeling of isolation, in sensitivity towards others, affective relation difficulties, social life difficulties, barriers in making friends, social isolation, difficulty in decision making about personal life, and uncontrolled aggressiveness (**Branco, 2010**).

**Chraiti et al., (2005)** and **Cardoso, Mascarenhas and Oliveira (2010)** mentioned that factors that contribute to hazards and risks may include lack of time,k knowledge, forgetfulness, lack of means, negative influence of the equipment on nursing skills, uncomfortable equipment, lack of training, conflict between the need to provide care, self-protection and distance to vital / essential supply, equipment or facility (**Branco et al., 2010, Bianchi et al., 2016**). Additionally, **Aliyu and Auwal, (2015)** reported that hazards might results from poor supervision, insufficient experience on the job (**Burdorf and Ijzelenberg, 2014**). In Egypt, at a university hospital a study carried by **Abou El-Enein and El Mahdy, (2011)** reported about factors and barriers influenced safety practice measures which interfered with the safe practice of care such as: absence of role model from colleagues or superiors, the high work load or lack and inaccessibility of supplies (**Cardoso et al., 2010**).

Use of personal protective equipment is ordered by the Occupational Safety and Health Administration for healthcare workers to prevent infection with blood borne disease such as human immunodeficiency (**Ali et al., 2010, Akintayo, 2013, Leiss, 2014, Assefa et al., 2016**).

**OSHA, (2019)** have been stated that A critical element of any effective safety and health program is a proactive, ongoing process to identify and assess such hazards by health care employers and workers which include; Collect and review information about the hazards present or likely to be present in the workplace, conduct initial and periodic workplace

inspections to identify new or recurring hazards, Investigate injuries, illnesses, incidents, and close calls/near misses to determine the underlying hazards, their causes, safety and health program shortcomings, Group similar incidents and identify trends in injuries, illnesses, and hazards reported. Consider hazards associated with emergency or non-routine situations and determine the severity and likelihood of incidents that could result for each hazard identified, and use this information to prioritize corrective actions (Abidoeye et al., 2016).

Training in nursing is a combination of both theoretical and practical learning experience that qualify nursing students to acquire the knowledge, skills, and attitudes for provision of nursing care (Abdulla, 2008), in an unfamiliar and complex clinical environment that exposes them to a lot of risks over their formative educational years (Egyptian Ministry of Health Infection Control Guidelines, 2016).

Clinical training which occurs in a complex clinical learning environment is influenced by many factors. This environment gives an opportunity to nursing students for learning experimentally and to converting theoretical knowledge into a diversity of mental, psychological and psychomotor skills which are significant to patient care ( Gaberson et al. 2014, Eljedi, 2015). Exposure of students and their preparation to enter the clinical setting are one of the major factors which transform the quality of clinical education (Fletcher et al., 2015, Joolae et al. 2015).

Student training is decisive to the effective management of risk exposures that resulting from the interaction of individuals to biomedical technology. Therefore, the necessity for staff training generally and/or in cross training to achieve specific need is not exclusive to permanent personnel of the institution as many studies on accidents encompassed nursing students during the work of their clinical practice have discovered that rates of biological risk exposure (e.g. eye splashes, punctures, and cuts) exist as very high (Benner et al., 2010).

Nurse educators play a pivotal role in promoting evidence about operation of undergraduate education including skills of clinical safety that focus on ensuring and promoting the safety of the patient and the student , through enhancing patient safety awareness, using clinical reasoning, clinical expertise and integrity of ethics which are needed for practice improvement (Benner et al., 2010). However, Killam and Heerschap, (2013), posited that there is insufficient knowledge into the nature of clinical circumstances that affect on the development of a safety consciousness from a student perspective (Hada et al., 2018).

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

Healthcare facilities likewise other high risk clinical work settings characterized by a high level of exposure to hazardous agents, which hurt dramatically the health and life of healthcare workers (Hassan, 2014). Thus, World Health Organization centered on the primary prevention of workplace hazards, particularly due to the highest incidence of occupational injuries occurs in hospitals, comparably to the construction and manufacturing industries (Hazard Communication Standard, 2017).

So, as managing risk is a proactive function, therefore, maintaining safety and developing undergraduate nursing students' knowledge and skills in relation to clinical risk assessment and management by attending training is compulsory. Working collaboratively with nursing staff and faculty members in order to provide high quality risk assessment and management for students, reporting all incidents relating to clinical risk assessment and management in line with requirements of the incident reporting policy and actions to be taken to reduce the frequency and severity of unexpected incidents or prevent the risk of recurrence.

#### **Aim of the study:**

The present study aimed to evaluate the effect of implemented risk management and safety measures' educational interventions on knowledge and practice of undergraduate nursing students.

#### **Research hypothesis:**

It was hypothesized that by the completion of the risk management and safety measures interventions that the undergraduate nursing students will acquire the knowledge and clinical performance of safety measures related to risks in clinical settings.

## 2. SUBJECTS & METHODS

**Design:** A quasi experimental study was applied.

**Setting:** The study was conducted at the Faculty of Nursing and Tanta University Hospitals (Medical, General & Emergency Surgery and Oncology Departments) that affiliated to Tanta University, Egypt.

### Subjects:

All available students (219) enrolled in 2<sup>nd</sup> year of Nursing Faculty were exposed to the study, while the total number of the students who completed whole program was 144 students representing response rate of 65.75%.

### Tools of Data Collection:

The data collection tools were developed and modified by the researchers based on the current literature reviews (Abdulla, (2008), Egyptian Ministry of Health infection Control Guide (2016) and Safety Data Sheets, (2017). The study included three tools are described as following:

#### Tool I: Risk questionnaire sheet.

This tool aimed to assess the students' knowledge on the medical concepts, all types, sources and levels of risks. The tool consisted of two main parts:

**First part "Socio-demographic Data"** included student's name, code no., gender, age, marital status, place of residence, Educational level prior to joining the nursing faculty, attended training on risks management.

**Second part "Knowledge of Risk Assessment"** composed of 22 questions (multiple choices questions with multiple responses) under four categories that entitled Medical concepts, Types, Sources, and Levels of risks; Medical concepts of risks (four questions), Types of risks with one question (8 items), Sources of risks with fourteen questions which described as; Biological source (5 items), Chemical source (10 items), Electrical source (5 items), Microbial source (5 items), Medical wastes source (13 items), Physical source (3 items), Hospital Acquired Infection source (10 items), Medical Radiation source (3 items), Misuse of medical equipment and devices source (9 items), Biophysical source (5 items), Psychosocial source (3 items), Environmental source (3 items), Ergonomic source (10 items), violence source (5 items), and levels of risks (one question).

#### Scoring system

The students were asked to tickle all available correct answers for all questions, the cut-off value scored as following;

- $\geq 70\%$  of correct answers scored (2)
- $\leq 70\%$  of correct answers scored (1)
- No answer scored (0)

#### Tool II: "Safety Measures Questionnaire Sheet"

It was a structured questionnaire aimed to assess students' knowledge of safety measures. The questionnaire composed of 38 questions divided into (13 true and false questions and 25 multiple choices questions) under nine categories that entitled Hand Hygiene (5 questions), Personal Protective Equipment (11 questions), Safe Injection (3 questions), Needle Puncture Measures (3 questions), General Safety Measures (6 questions), Mercury Toxicity Exposure (4 questions), Radiation Exposure (3 questions), Cytotoxic Drugs Exposure (2 questions), Spillage Management (1 question).

#### Scoring system

The students were asked to select only one correct answer, the correct answer scored (1) and the false answer scored (0).

The levels of students' knowledge of risk assessment and safety measures were classified as following:

- Poor  $< 60\%$
- Fair  $60\% - < 70\%$
- Good  $\geq 70\%$

**Tool III: Observed Clinical Performance Checklist:**

The checklist was designed by researchers and structured from 28 statements to observe students' clinical performance related to risk management and safety measures which used to evaluate the effect of the educational training intervention on the performance of the students. The statements of the clinical performance checklist were grouped to fourteen categories entitled to; Hand hygiene, Donning PPE, Applying safety measures to avoid risk, Applying principles of safe injection practices, Protecting self and others from blood and body fluid exposures, Applying safety measures to radioactive exposure, Applying measures to chemotherapy exposure, Applying measures to medication errors, First aid measures for mercury toxicity exposure, Using first aid kit for skin injury, Using spill management kit for environmental decontamination, Applying protocol of hepatitis exposure, Fill up incidence report, Reporting any risk occurrence to clinical instructor or unit head nurse.

The scoring system of clinical performance checklist scored with likert scale as done scored (1), not done scored (0), and each not applicable item scored (-1). The total sum of all done performance scores were computed as the induced result of the expected outcome of students' performance.

- From < 60 % of the total score indicates poor practice.
- From 60 – less than 70 % of the total score indicate satisfied practice.
- From  $\geq$  70 % of the total score indicate good practice.

**Face and Content validity:** It was ascertained by two groups of experts; first group composed of (3) professors from Faculty of Nursing at Tanta University and Faculty of Applied Medical Science at Misr University for Science and Technology. They represented the scientific reviewers for risk management and safety measures student booklet.

The second experts group included (5) staff from public health and community health medicine, faculty of medicine, medical surgical nursing, nursing administration, departments, Tanta university. Their opinions were elicited regarding to the tools format layout, consistency and scoring system. The tools were tested regarding to the knowledge accuracy, relevance and competence.

**Ethical considerations:** In the planning stage, approval was obtained from the dean of the faculty, head of medical surgical nursing departments, medical and nursing directors of hospital at Tanta University Hospitals. Confidentiality and anonymity was maintained by the use of code number instead of name. The studied nursing students were informed by the researchers about the aim and procedures of the study and their rights according to research ethics to withdraw from the study at any time.

**Pilot study:** A pilot trial was carried out on 10% of the total study sample to test the clarity and practicability of the tools, in addition to subjects and settings. It was done to determine any obstacle that may encounter during the period of data collection accordingly needed modifications was done. Pilot subjects were later excluded from the study as there were no radical modifications in the study tools. The time consumed for the students to fill up their responses in risk management (**Tool I**) was 15-20 minutes, and 15-30 minutes for safety measures assessment knowledge questionnaire (**Tool II**).

**Field Work**

The objectives of the educational interventions had been achieved across four main stages that are described below:

**I. Preparation**

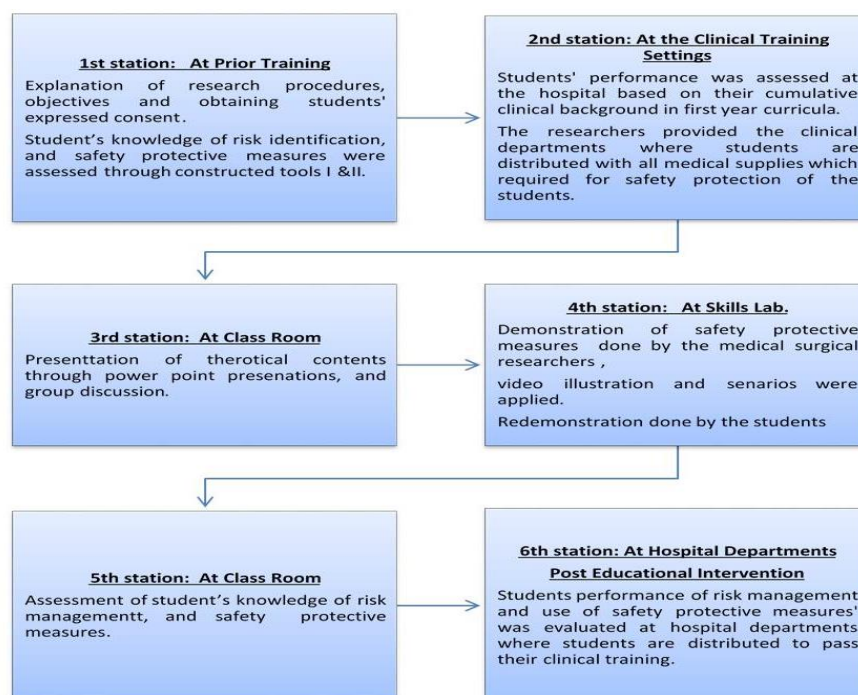
Upon obtaining the ethical approval for the study, the preparation of the educational interventions started and continued for eight months, from August 2018 until February 2019. During this period, the researchers prepared a plan for scheduled meetings to discuss and approve researchers' assignments concerning (a) data collection tools preparation, (b) the objectives and content of the guide booklet of risk management, (c) the expected performance outcome, (d) preparation of the education methods and materials, (e) purchasing of the medical supplies of the first aid bags and spillskits, in addition to other protective supplies (f) preparation of the class room and skills labs for demonstration and re-demonstration, (g) preparation of students schedules of distribution, The web engines were searched for all recent literatures related to risk management, safety protective measures, and risk management plan for the undergraduate students of Nursing Faculty. Including acceptance from the dean about developing policy and procedure related to risk event through using incident report to report any risk event occurrence to the undergraduate nursing students during their training.

## II. Planning

- Guide Booklet was developed for undergraduate students on Risk management and safety measures aimed to guide the students on risk management and safety measures related to various risk events.
- The contents of the instructional booklet gathered from different sources and search related literature reviews (**Applied Medical Sciences K.S.A. Colleges (2015)** and **Hazard Communication Standard: Safety Data Sheets, (2017)**) that indexed risk identifications, risk avoidance, and safety measures related risks which encompasses terms definitions, Risk avoidance and prevention, Hand hygiene, Personal protective equipment, Safe injection practice, General safety recommendations, Risk identification and treatment, Exposure to blood and body fluids, Exposure to cytotoxic hazardous agent, Physical assault on students Exposure to radiation, Student medication errors, Vaccination of hepatitis B, and Student incident report.
- The developed booklet designed in Arabic and English language – copy right number (IBN 2018/ 20112 / Egyptian Book House).
- The instructional booklet and educational interventions were designed based on analysis of the actual educational nursing students’ needs assessment in pre-test by using the pre constructed tools.
- Designing of incident report form and formulation of policy and procedures related risks exposures were approved by the dean of the nursing faculty as a routine procedure to document and manages students' risks.
- The sessions of educational interventions contained (4) sessions; (2) theory and (2) practical. Each practical session contained 10 groups of students, and each group gathered (14 students).
- Teaching methods and aids were used during the session covered three domains of education: group discussions, demonstration and re-demonstration.
- Teaching aids included; Arabic – English language guided booklet, data show and power point presentation.

## III. Implementation

The implementation of the educational interventions of risk management and safety measures was established through the following six stations.



**Work Flow Diagram for the Educational Interventions**

### **The First Station**

This station aimed to assess student's knowledge of risk management and safety measures. Announcement for all second year students was posted in the faculty board to attend a class room in a specific calendar date at 9'Oclock in the morning. Upon the arrival of the majority of the students, the researchers have explained the reason for the meeting, the aim for the study, the benefits from the study and finally the processes of conducting the study. Students' attendance was checked prior the explanation of data collection tools I & II.

### **The Second Station**

This station aimed to measure students' practices at the clinical training settings in four departments; medical, surgical, emergency and oncology (tool III) prior giving theoretical and practical training in order to evaluate to which extent the students will use the safety protective measures and manage risks events.

The researchers in link with the head nurses of the medical departments provided one batch of medical supplies which funded by the researchers and consumed total cost of 3000 Egyptian pounds which included first aids safety bags, spills management kits, sharp containers, latex gloves, hand scrub substances, disposable bags for wastes segregation (waste management) and disposals.

### **The Third Station**

This station conducted at class room and aimed to equip students with necessary knowledge related risk management and safety protective measures. The theoretical knowledge was given over two sessions as students divided into 2 groups.

Each individualized student had received a hard printed copy from the Guide Booklet. The power point presentation extended for 2 hours and the students who were absent in the first presentation had joined the second group presentation.

### **The Fourth Station**

This station was conducted in the skills labs of medical-surgical nursing department at the faculty of nursing, and aimed to acquire the students with the skills required for risk management. All 144 students were divided to ten groups, each group composed of 12-14 students' presided by one researcher for demonstration of the planned skills of types and sources of risks and risk management. All the students underwent re-demonstration of the safety measures.

### **The Fifth Station**

This station aimed to measure the retained knowledge of risk identification and the safety measures. Like as in the 3<sup>rd</sup> station, the students were met to repeat the measurement of knowledge related tools (tool I. and tool II) and they had divide over 2 classes to prevent crowdedness.

### **The Sixth Station**

In this station, the students were evaluated using the performance observation checklists (tool III) in actual situations at the mentioned hospital departments. The Performance observation checklists were observed (4 times) for each student in their assigned department.

Refilling of medical supplies was replaced by second batch according to inventory counts checked and replaced by the researchers.

## **IV. Evaluation**

A comparison was done between the results of both pre and post-test immediately post educational interventions to evaluate effect of risk management and safety measures on nursing students' knowledge and practice.

### **Statistical design:**

The collected data were reviewed and arranged, coded, analyzed and tabulated, using statistical package of the social sciences "SPSS" software version 20. Data was presented using descriptive statistics in the form of frequencies distributions and percentages, means, standard deviations. T-test was calculated to compare prior and post educational interventions at pre. A statistical significance was considered at P- value <0.00.

Table (1): Frequency distribution of the studied undergraduate nursing students to their socio-demographic characteristics

Characteristics	The studied students(n=144)	
	N	%
<b>Sex</b>		
▪ Male	37	25.7
▪ Female	107	74.3
<b>Age (in years)</b>		
▪ 18.0	3	2.1
▪ 19.0	119	82.6
▪ 20.0	22	15.3
<b>Range</b>	(18-20)	
<b>Mean ± SD</b>	19.14±0.39	
<b>Marital status</b>		
▪ Single	143	99.3
▪ Married	1	0.7
<b>Residence</b>		
▪ City	50	34.7
▪ Rural	94	65.3
<b>Previous training on risk assessment and management</b>		
▪ No	135	93.8
▪ Yes	9	6.3
<b>Educational level</b>		
▪ Technical Nursing Institute	17	11.8
▪ Secondary	127	88.2

Table (1) showed the frequency distribution of the studied undergraduate nursing students to their socio-demographic characteristics. More than two thirds of the students were females (74.3%), the mean age of the sample was ( $\mu$ 19.14), and most of them were singles. More than half of the students' lives in rural areas, and (93.8 %) haven't any previous training on risk assessment and management. Regarding their previous educational level, the majority (88.2%) of them were graduated from general secondary school.

Table (2): Mean scores of knowledge domains on risk assessment of studied undergraduate nursing students' pre and post educational interventions

Domains	The studied students (n=144)		Mean difference	t- test	P
	Pre	Post			
1. Medical concepts related to risk	2.57±1.001	3.06±0.809	0.486	4.533	0.000*
2. Types of risk	1.28±0.724	1.74±0.442	0.458	6.485	0.000*
3. Sources of risk	18.20±5.680	23.24±3.528	5.035	9.036	0.000*
4. Levels of risk	0.22±0.616	0.66±0.518	0.444	6.626	0.000*

\* Significant at level  $P < 0.05$

Table (2) displayed the mean scores of knowledge domains about risk assessment of studied undergraduate nursing students' pre and post educational intervention. The mean differences in the four domains of knowledge evident on improvement of knowledge from pre-intervention to post-intervention with high statistical significance differences ( $p=0.000$ ) in the compared t-test. The lowest mean scores were in the levels of risks, and then moved to types of risks, and medical concepts related risks while sources of risks got the highest mean score.



**Table (3): Mean scores of knowledge domains about safety measures of the studied undergraduate nursing students' pre and post educational interventions**

Domains	The studied students (n=144) Mean ± SD		Mean difference	t- test	P
	Pre	Post			
1. Hand hygiene	3.51±0.819	3.90±0.693	0.389	4.350	0.000*
2. Personal protective equipment	8.81±1.604	9.64±0.972	0.826	5.287	0.000*
3. Safe injection	2.81±0.542	2.95±0.216	0.139	2.859	0.000*
4. Needle puncture measures	1.06±0.661	2.85±0.380	1.785	28.098	0.000*
5. General safety guidelines	4.26±1.044	5.39±0.730	1.125	10.594	0.000*
6. Exposure to mercury toxicity	1.56±0.981	3.82±0.468	2.264	25.00	0.000*
7. Radiation Exposure	0.31±0.832	2.92±0.292	2.611	35.549	0.000*
8. Cytotoxic drugs exposure	1.68±0.665	1.92±0.315	0.243	3.963	0.000*
9. Spillage management	0.10±0.297	0.96±0.201	0.861	28.816	0.000*

\* Significant at level P < 0.05.

Table (3) the knowledge of the students was illustrated over 9 domains which distributed between lowest mean in spillage management and highest mean in applying the personal protective equipment. Regarding pre-intervention, the other most three domains demonstrated in high means were respectively; applying general safety guidelines, hand hygiene, and safe injection. The same was demonstrated in post-intervention, in addition to the exposure to mercury toxicity.

The means differences in the nine domains of knowledge about safety measures evident on improvement of student's knowledge from pre-intervention to post-intervention with high statistical significance differences (p=00.0) in the compared t-test.

**Table (4): Frequency distribution of the studied undergraduate nursing students to their knowledge level about risk assessment and safety measures (pre and post educational interventions)**

Knowledge domains	The studied students (n=144)				$\chi^2$	P	t-test for equality of mean
	Pre		Post				
	N	%	N	%			
<b>Level of risk assessment knowledge</b>							
▪ Poor	68	47.2	7	4.8	74.48	<b>0.000*</b>	
▪ Fair	25	17.4	22	15.3			
▪ Good	51	35.4	115	79.9			
<b>Mean ± SD</b>	<b>22.26±6.282</b>		<b>28.69±3.820</b>				<b>t=10.484 0.000*</b>
<b>Level of safety measures knowledge</b>							
▪ Poor	40	27.8	0	0.0	193.204	<b>0.000*</b>	
▪ Fair	77	53.5	1	0.7			
▪ Good	27	18.8	143	99.3			
<b>Mean ± SD</b>	<b>24.11±4.211</b>		<b>34.35±2.107</b>				<b>t=26.102 0.000*</b>
<b>Total level of knowledge</b>							
▪ Poor	62	43.1	0	0.0	150.729	<b>0.000*</b>	
▪ Fair	40	27.8	2	1.4			
▪ Good	42	29.2	142	98.6			
<b>Mean ± SD</b>	<b>46.38±8.438</b>		<b>63.04±4.654</b>				<b>t=20.754 P=0.000*</b>

Poor < 60 %

Fair 60 % - < 70 %

Good ≥ 70 %

Table (4) revealed the frequency distribution of the studied undergraduate nursing students in pre and post educational interventions on the knowledge levels of risk assessment and safety measures. Prior intervention, regarding students' level of knowledge on risk assessment, the mean score and standard deviation was (22.26±6.282) and improved to (28.69±3.820) post interventions (t=10.484). While the level of knowledge on the safety protective measures, prior intervention, the mean score and standard deviation was (24.11±4.211) and improved to (34.35±2.107) post interventions (t=26.102) with high statistical significance differences (p=00.0).

**Figure (1): Percent distribution of the studied undergraduate nursing students to their knowledge level about risk assessment and safety measures (pre and post educational interventions)**

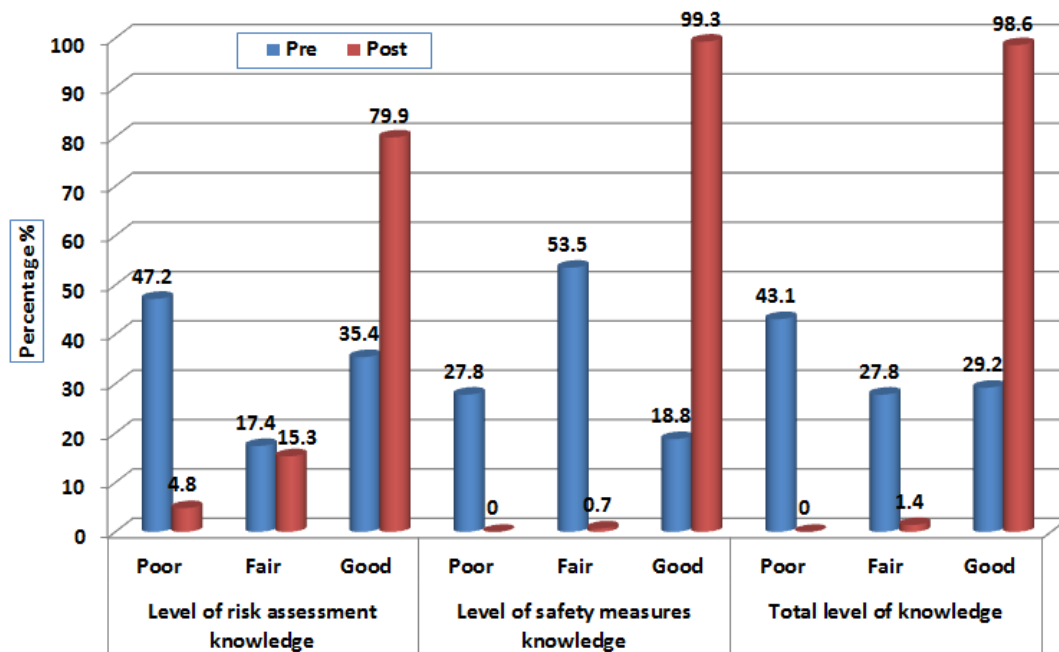


Figure (1) illustrated the percent distribution of knowledge level on risk assessment and safety measures of the studied undergraduate nursing students' pre and post educational interventions. Prior educational intervention (47.2 %) of the students proven proved poor knowledge and (35.5 %) good knowledge compared to (79.95) of good knowledge on risk assessment post interventions.

Regarding safety measures, prior educational intervention more than half (53.5%) got fair knowledge and around one third (27.8%) got poor knowledge compared to (99.3%) as good level of knowledge post- intervention, and consequently, the total knowledge level was good (98.6%).

**Table (5): Mean scores of observed clinical performance of the studied nursing students' pre and post educational interventions**

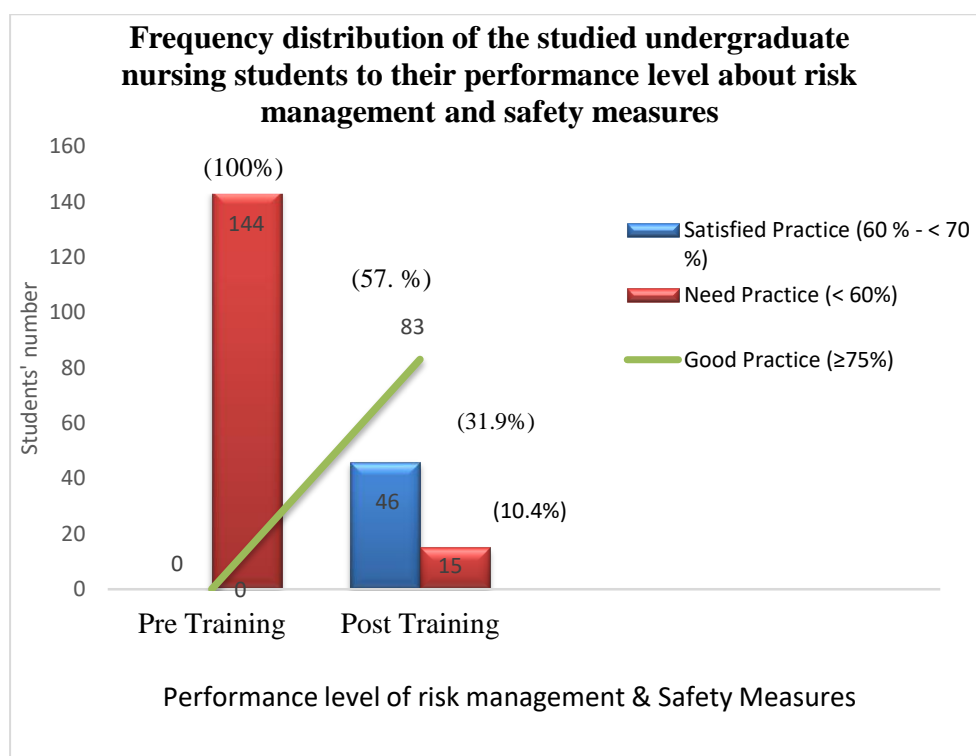
Performance domains	The studied students (n=144) Mean ± SD		t-test	P
	Pre	Post		
1. Hand hygiene	4.01±1.343	8.11±1.025	29.101	0.000*
2. Donning PPE	3.40±2.282	6.92±2.292	13.065	0.000*
3. Applying safety measures to avoid risk	3.08±1.780	7.51±2.082	19.379	0.000*
4. Applying principles of safe injection practices	1.39±1.072	2.48±0.885	9.415	0.000*
5. Protecting self and others from blood and body fluid exposures	0.66±1.135	2.38±0.70	15.497	0.000*
6. Applying safety measures to radioactive exposure	0.90±1.969	1.22±2.239	1.286	<b>0.200</b>
7. Applying measures to chemotherapy exposure	0.86±1.728	2.26±1.865	6.587	0.000*
8. Applying measures to medication errors	4.26±1.408	5.47±1.229	7.804	0.000*
9. First aid measures for mercury toxicity exposure	0.03±0.802	1.22±1.203	9.916	0.000*

10. Using first aid kit for skin injury	-0.64±0.772	1.68±1.352	17.88	0.000*
11. Using spill management kit for environmental decontamination	-0.89±0.315	1.83±1.171	26.942	0.000*
12. Applying protocol of hepatitis exposure	-2.60±0.777	3.02±2.571	25.134	0.000*
13. Fill up incidence report	-1.00±0.00	2.16±0.994	38.141	0.000*
14. Reporting any risk occurrence to clinical instructor or unit head nurse	0.97±0.728	2.27±0.895	13.508	0.000*
<b>Total performance score</b>	<b>14.43±6.888</b>	<b>48.53±8.51</b>	<b>t=37.38</b>	<b>P=0.000*</b>

\* Significant at level P < 0.05

Table (5) portrayed the mean scores of observed clinical performance of the studied nursing students' pre and post educational intervention. Evaluation of students' performance was distributed over fourteen domains. In pre-intervention, the highest five top domains were respectively; applying measures to medication errors, hand hygiene, donning PPE, applying safety measures to avoid risk, and applying principles of safe injection practices. Performance of hand hygiene was on the five top domains after students training followed by applying safety measures to avoid risk, donning PPE, applying measures to medication errors, and applying protocol of hepatitis exposure. While in post-intervention, there were marked improvement in the observed clinical performance with statistical significance differences (p=00.0) except in applying safety measures to radioactive exposure.

**Figure (2): Frequency distribution of the studied undergraduate nursing students to their performance level about risk managements and safety measures**



(pre and post educational interventions)

Figure (2) evident on the frequency distribution of the studied undergraduate nursing students to their performance level on risk management and safety measures pre and post educational interventions. The total number of students were evaluated as needs practice in prior intervention (100%) while in post- interventions, only (10.4 %) of nursing students needed practice and (57.7 %) of them were good practice post educational interventions for risk management and safety measures with high statistical significance differences (p=00.0) and  $\chi^2$  (233.66).

Table (6): Relation of Socio-demographic characteristics of the studied undergraduate nursing students to their level of knowledge and performance Post Educational Interventions

Socio-demographic characteristics	Total level of knowledge					Total performance level						
	Post				$\chi^2$ P	Post						
	Fair (n=40)		Good (n=42)			Need practice (n=15)		Satisfied (n=87)		Good (n=42)		$\chi^2$ P
	N	%	N	%		N	%	N	%	N	%	
<b>Sex</b>												
▪ Male	0	0.0	37	25.7	FE	2	1.4	24	16.7	11	7.6	1.369
▪ Female	2	1.4	105	72.9	1.00	13	9.0	63	43.8	31	21.5	0.504
<b>Previous training on risk assessment and management</b>												
▪ No	2	1.4	133	92.4	FE	11	7.6	82	56.9	42	29.2	13.509
▪ Yes	0	0.0	9	6.3	1.00	4	2.8	5	3.5	0	0.0	0.001*
<b>Residence</b>												
▪ City	0	0.0	50	34.7	FE	5	3.5	31	21.5	14	9.7	0.08
▪ Rural	2	1.4	92	63.9	0.544	10	6.9	56	38.9	28	19.4	0.961
<b>Level of Previous Education</b>												
▪ T N I	0	0.0	17	11.8	FE	1	0.7	5	3.5	11	7.6	0.586
▪ Secondary	2	1.4	125	86.8	1.00	14	9.7	41	28.5	72	50.0	0.746
<b>Departments of Clinical Practice</b>												
▪ Medical	0	0.0	43	29.9		3	2.1	16	11.1	24	16.7	
▪ Emergency surgeries	0	0.0	28	19.4	6.085	1	0.7	6	4.2	21	14.6	9.950
▪ General surgery	2	1.4	34	23.6	0.108	7	4.9	14	9.7	15	10.4	0.127
▪ Oncology	0	0.0	37	25.7		4	2.8	10	6.9	23	16.0	

FE: Fisher' Exact test \* Significant at level P < 0.05

Table (6) showed the relationship of socio-demographic characteristics of the studied undergraduate nursing students to their level of knowledge and performance post educational interventions. Related both knowledge and performance levels, the female students with good knowledge were higher than male students as well as the students without previous training have got good knowledge than those who have previous training. While, students lived in rural areas got good knowledge than those lived in cities. As well as students graduated from secondary school got good knowledge than those with technical nursing institute.

While, the level related to the distribution of students in the medical departments, there were almost equal levels in knowledge and performance.

### 3. DISCUSSION

The concept of patients' safety was highly investigated in huge literature review, while the safety concern of undergraduate nursing students' was scarce in literature of either international or national studies. This conclusion was supported by **Mark et al., (2007)** as documented that there were few descriptive studies focused on the accidents at work setting, in addition to, safety at work which focused on the compliance to regulation, and attitude of individuals (**Kalokairinou et al., 2011**).

The socio-demographic profile of the studied students showed that more than two thirds of the students were females, the age ranged from 18-20 years. This finding was similar to **Mahades and Vaishali (2014)** as revealed in their study of assessment of knowledge, attitude and practices of five moments of hand hygiene among nursing staff and students at a tertiary care hospital at Karad, 96% of female student nurses and 4 % only of male student nurses with 90% of student nurses were belonging to the age group of 19-25 years. In this study, most of the students were singles, more than half of them lives in rural areas, very few percent of students got previous training on risk assessment and management. This

could be explained in this area of town because it is suburban and accepting all students who are inhabiting beside this faculty but because the demographic area and the low economic status does not let them to have chance for training more courses related to their profession. Regarding their previous educational level, the majority of them were graduated from general secondary school. In this study the researchers targeted particular domains in students' knowledge of risk assessment and safety measures and performance related risk management.

**Firstly**, risk assessment knowledge of studied undergraduate nursing students was examined pre and post educational interventions. The risk assessment knowledge included four domains. Students' knowledge about sources of risks got the highest mean score which included eight sources, while the lowest mean scores were in the students' identification to the levels of risks, and then moved up to the types of risks, then up word to medical concepts of risks. The means differences in the four domains of knowledge evident on improvement of knowledge from pre-interventions to post-interventions with high statistical significance differences ( $p=0.0$ ) in the compared t-test. In context, **Hebashy & Hassan, (2016)** assessed the perception of occupational hazards and protective measures among nursing interns' at Cairo University hospital in Egypt, they found that most of nursing interns exposed to many sources of hazards respectively were physical, chemical and biological hazards which seen as the lowest occurrences (**Killam et al., 2011**). Also, the majority of nursing interns perceived lack of educational programs, lack of regular medical examination, policies and procedures related to occupational safety. The students also reported about the inefficient supervision as considered the most contributing factors for occurrence of occupational hazards among intern during their clinical practice.

Regarding the induced low mean score of students' knowledge about the identification of risks levels, this finding may be due to the studied curriculum in the first year of education is devoid of talk about risk, especially its levels, although they studied topic related to patient safety. It is true that when students get a good chance in clinical training, they significantly will have better knowledge. In this regard, **Mahadeo et al., (2014)** declared this finding in his study of assessed knowledge, attitude and practices of five moments of hand hygiene among nursing staff and students at a Tertiary Care Hospital (**Killam and Heerschap, 2013**).

On other hand, in this study it was shown that the knowledge of the students towards safety measures was illustrated over 9 domains which distributed between low mean in spillage management and high mean in applying the personal protective equipment that can be interpreted as the second year students had previous experience in relation to applying personnel protective equipment while spillage management for undergraduate nursing students has nearly few experience about types of spillage management and how it will be applied in the clinical training settings. Whereas pre educational interventions the other most three domains demonstrated in high means were respectively; applying general safety guidelines, hand hygiene, and safe injection. This is can be explained as the students were exposed and trained in first year in the fundamentals of nursing course (skills lab.) about hand hygiene and different types of safe injections. The same was demonstrated in post-interventions, in addition to the exposure to mercury toxicity. In this aspect of post educational interventions, the mean score was improved in relation to exposure to mercury toxicity due to unawareness of undergraduate nursing students about how to deal with mercury toxicity exposure and no previous training passed about it.

The means differences in the nine domains of knowledge about safety measures evident on improvement of student's knowledge from pre to post educational interventions with high statistical significance differences ( $p=0.0$ ) in the compared t-test.

Prior educational intervention, around half of students' total percent assured with poor knowledge and more than one third got good knowledge with mean score and standard deviation ( $22.26\pm 6.282$ ), while compared to post interventions, the majority of the students assured good knowledge level on risk assessment with mean score and standard deviation ( $28.69\pm 3.820$ ).

Regarding safety measures, prior educational intervention more than half of students got fair knowledge and around one third got poor knowledge with mean score and standard deviation ( $24.11\pm 4.211$ ) compared post- interventions as almost all students proven good level of knowledge, and subsequently, good level of the total knowledge with mean score and standard deviation ( $34.35\pm 2.107$ ), which may be referred to the previous experience of nursing students about patient safety without going in-depth to risk management. The difference between means of knowledge post interventions related risks and safety measures, appointed that knowledge of safety measures was higher than knowledge of risks assessment.

During hospital clinical practice, students may have exposed to many hazardous events, with or without the availability of medical supplies that is used for protection was not the true north if not combined with knowledge and understanding followed by training on management and safety measures against various types of medical risks at least risks types pertained to clinical practices with patients.

**Secondly**, the researchers targeted particular domains in students' performance related to risk management and safety measures. Evaluation of students' performance was distributed over fourteen domains. In pre-educational interventions, the five top domains were respectively: applying measures to medication errors, hand hygiene, donning PPE, applying safety measures to avoid risk, and applying principles of safe injection practices. While in post educational interventions, there were marked improvement in the observed clinical performance with statistical significance differences ( $p=0.0$ ) except in applying safety measures to radioactive exposure. As resulted of educational training intervention, there were specific attitude of undergraduate nursing students toward exposure to radiation as anxiety and fear from the effect of radioactive exposure over them during their clinical training but they don't know how to deal with and prevent the radioactive exposure. Similarly, in the study **Hassan (2014)** which was implemented at the cardiac catheterization units of Cairo University Hospitals as its results displayed that awareness of health team was high regarding ergonomics hazards followed by biological hazards, while, the least perceived was radiological hazards followed by physical hazards **Kubheka,( 2014)**.

In the performance domains, the results showed that practicing of hand hygiene was on the top first practiced skills fulfilled by the nursing students with high score mean in respect to others evaluated domains. Hand hygiene is the most safety procedure the students have been learned and practiced before the initiation of and at completion of any nursing procedure. In agreement of **Mahadeo et al., (2014)** who reported as previously mentioned study that nursing students had better practices of the moments of hand hygiene than nursing staff.

One of the top domains in relation to applying measures to medication errors in support with **Durham & Alden, (2008)** who mentioned in their study about the recent analysis of 1,305 medication errors by nursing students over a 5-year period showed that the most common medication errors were those of omission and giving the wrong dose of a drug. Errors were primarily attributed to students' performance deficits with significant contributing factors identified as inexperience and distractions. **Kursun and Arsian, (2014)**.

Medication administration is a vital aspect of nursing practice and a critical component of nursing education curricula. Faculty in schools of nursing are concerned with teaching students about safe medication administration which is multifaceted and involves instruction about actions and uses of medications, safe dosage, side effects, and nursing implications. This finding what have appeared through the educational intervention in regard to post evaluation improvement in this performance.

While in protecting self and others from blood and body fluid exposures, the observed clinical performance of undergraduate nursing students was statistically significant improved post educational intervention. This result consistent with **Moreno-Arroyo et al., (2016)** as stated that, students with prior practical training have a stronger perception of biological risk than untrained students. In this way specific interventions could be designed to foster a safety culture at the university, which is added value to university education that goes beyond academic education. This is in support with **Hada et al., (2018)** who reported in the study of nursing students: A vulnerable health-care worker for needle sticks injuries in teaching hospitals that Nursing students are at utmost risk for NSIs, the prevention of which requires regular training and education.

In the same line, **Fletcher et al., (2015)** stated that healthcare providers are frequently exposed to many forms of infectious agents while doing their duties which may be preventable if they complied with standards precautions. **Bazeyo et al., (2015)** added that healthcare workers work in an environment that is deemed to be the most common hazardous occupational settings. Also, **Hebashy & Hassan, (2016)** showed that most of nursing interns exposed to MRSA followed by hepatitis C and B which known as a common cause of needle stick injury that outcome from nurses recapping of the infected needle, non-adherence to safety precautions standards.

Furthermore in this research, it was evident, significant improvement after educational intervention in the observed clinical performance of nursing students respectively; Applying protocol of hepatitis exposure, Fill up incidence report, reporting any risk occurrence to clinical instructor or unit head nurse. This finding supported by **Arrbasliorente et al., (2005)** as concluded that high percent of percutaneous accidents is caused by mal practices that are forbidden by standard recommendations such as needles recap.

In another Egyptian study conducted by **Hossein et al., (2016)** whose results showed high incidence of needle stick injuries because of un-follow of standards precautions. This finding indicates to significant deficiencies in security measures in addition, low effectiveness of theoretical and practical training that in turn prevent risks among college students. In this regard, the adoption of best practice in the ambition of risk management allows improvement of the safety practices among nursing students (**Veridiana et al., 2013**). It is in congruent with Indian study revealed that most of nursing students had high incidence of needle stick injuries (**Arazoo et al., 2015**).

Quena University Hospital also carried out a study by, **Morsy and Sabram (2016)** who mentioned that most of nursing interns exposed to chemical hazards due to exposure to natural latex gloves and other latex-containing medical devices, followed by eyes, nose, and throat irritations. Additionally, **Eliakimu, Manyele and Ngonyani, (2008)**, reported that the used chemicals in hospitals for cleaning such as antiseptics and disinfectants may contribute skin burns during handling and utilization.

In the current research, the students confronted a number of five incidents up on completion of their training regarding risk management and safety measures. The students were comprehensively complied with the set policy and procedures of risk events concerning fulfillment of the designed incident report form which was approved previously by the dean of the faculty combined with the approved policy and procedures of student risks exposures at clinical training settings. This policy had made to enhance the safety of the students who not only involved in the current study but also, for the entire faculty students, such practice of risk management and safety measures for the undergraduate nursing students in clinical training settings when established, more trusting relationship between nursing students, clinical instructors, staff nurses and faculty management will be established. The students were able to behave in certainly environment and follow the process of reporting assertively.

However, as explained by **Shozo, (2001)** that, when an accident appears to have been the fault of a single individual, the cause may be in the management system of the hospital and nursing college. Therefore, it is important that the involved person reports the accident faithfully and this system should be capable for evaluating such incidents objectively in a continuous process between the faculty and the hospital.

Regarding the relationship of socio-demographic characteristics of the studied undergraduate nursing students to their level of knowledge and performance post educational interventions, there were normal distribution of students proportion related to their numbers with no obvious statistical significant differences among levels of knowledge and performance. As revealed in both knowledge and performance levels, the female students with good knowledge were higher than male students, while the students without previous training demonstrated good knowledge than those who have previous training which interpreted as this training was about general scope of safety.

Meanwhile, students lived in rural areas assured good knowledge than those lived in cities due to lacing of fashions of entertainments unlike in cities wherein students are occupied with luxury which impact on their level of education. Also, the students graduated from secondary school assured good knowledge and performance than those with technical nursing institute which indicate to the level of understanding and maturation of secondary school students. No indicator on the level of students related to their distribution in the medical departments, there were almost equal levels in knowledge and performance.

By comparing the students' performance on risk management and safety measures in relation to the availability and accessibility of safety protective medical supplies and equipment, it was asserted that the consumption and usage of these items depends accordingly on students' knowledge and practicing applications of safety measures and perform simulation on risk management in addition to reporting a real events of risks events, which in turn ultimate the value of students training.

### Study Limitation

Many limitations were raised alongside the study;

- No storage place was available to store the medical supplies, and first aids kits.
- The research funded by the researchers only.
- Resistance of the faculty clinical instructors to handled assistance in lab demonstration.
- All the students' population passed the learning experience of risk management, while students who didn't complete the entire processes of the study were excluded from the results.
- Difficulty to engage the entire community of faculty nursing students to participate in the study.

### 4. CONCLUSION

The risk management and safety measures educational interventions achieved its expected outcome as revealed in the total level of knowledge regarding risk assessment and safety measures were 98.6 % as induced as good knowledge and two third of undergraduate nursing students evaluated with good practice on risk management and performance of safety measures post educational interventions.

### 5. RECOMMENDATION

**Concerning current research**, it was recommended to broaden this experience in term of preparing faculty risk management plan for students' clinical training including availability to;

- Fund first aid and spill kits supplies.
- Train the students before commencing of hospital clinical training.
- Interact with medical insurance hospital for students to apply serology screening for all students upon their acceptance to apply to the nursing faculty.
- Interact with the medical insurance hospital to analyze the serology antigen in care of students' needle stick injury.
- All students are recommended to receive poster dose for Hep B.

#### For further research

- Generalize the current used approach of risk assessment and safety measures program over all nursing faculties in order to equip the nursing students with necessity knowledge and skills that contributes to their safety during their clinical training.
- Other medical disciplines of medical colleges as medicine, dentistry, pharmacy, physical therapy and science colleges may utilize a risk assessment and safety measures program into their curricula.

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