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Effect of nursing guidelines compliance to infection control among nursing student

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Abstract:
Background: *Nurses in particular are often exposed to various infections during the course of carrying out their nursing activities. Therefore nurses should have sound knowledge and strict adherence to infection control practice.aim of the study: was to measure the effect of nursing guide line on compliance of medical surgical nursing students regarding infection control measures at faculty of nursing Menofia University.*
Subject and methods: *Quasi-experimental research design with pre, post and follow up was used to achieve the aim of the study. Setting: The study was carried out at university hospital during training of nursing students, Menofia University.-*
Subjects: *A sample of 100 students at second year academic medical surgical nursing students at faculty of nursing Menofia University. Tools for data collection: Three tools were used to collect the data for this study. Medical surgical nursing student's knowledge regarding infection control measures structured questionnaire sheet, performance observational check list related to infection control measure and attitude related to infection control measure scale. Results: majority of both groups weren't trained previously on infection prevention precautions, most of both groups indicated the common barriers to comply with infection control precaution as lack of knowledge then lack of equipments with highly significant improvement of knowledge among study group than control group after intervention and highly significant improvement as positive attitude among study group than control group. Positive correlation between knowledge regarding infection prevention precautions and its compliance among study group in both post and follow up teaching.*
Conclusion: *The majority of student nurses experienced lack in their knowledge and practices regarding universal precaution of infection control and this lack was corrected after implementation of the nursing guide line, the most frequent causes behind these defects was due to lack of training of infection control precautions.*
Recommendations: *Periodic refreshing training courses should be provided in order to keep the student nurses of updating knowledge and practices regarding universal infection control precautions.*
Key words: *nursing guide line, infection control, compliance*

I. Introduction:

Infection control standards become an integral part of the accreditation program for all medical settings in Egypt. **(1)** Infection control standard precautions include certain measures such as hand hygiene, sharps safety, staff health, use of personal protective equipment (PPE), equipment safety, waste management and environmental cleaning. Many infection control measures, such as appropriate hand hygiene and the correct application of basic precautions during invasive procedures are simple and of low-cost **(2).**

Student nurses are often exposed to various infections during their clinical education, **(3)** and as health care workers, nursing students have a huge responsibility to protect themselves, their families, and their patients from danger because they work in an environment that encourages infections, and health care is always facing new dangers from incurable infections **(4).** Infection control measures, such as appropriate hand hygiene and the correct application of basic precautions during invasive procedures are simple and of low-cost, but require staff accountability and behavioral change, in addition to improving staff education, reporting and surveillance systems [(2)]. To utilize these precautions, the human element plays an important role in increasing or decreasing the chances of catching HCAI [(5).] Therefore, adequate nursing staff is necessary because a higher patient-to nurse ratio increases the risk of nosocomial infection [(6).]

Transmission of infectious agents within a health care setting requires three agents; a reservoir, susceptible host, and a mode of transmission. Patients' health care workers and visitors are susceptible host in the hospital environment. The mode of transmission may vary by type of organism as some types of organism may be transmitted more than one route. The complex interrelationship between a potential host and an infectious agent produces infection [(7)]. Compliance on the part of healthcare workers with standard precautions has been recognized as an efficient and effective means to prevent and control health care-associated infections in patients and health workers [(7)].

So Nurses are the heart and hands of the health team and they comprise the first line care providers to the patients, who apart from giving drugs or rendering routine care to patients. This would mean constant

contact and exposure with various nosocomial infections present in the hospital setting. It is the duty and responsibility of nurse to strictly comply and adhere to the hospital's preventive measures against nosocomial infections and other infectious diseases. Furthermore, nurses as healthcare workers should be aware of the ways to slow down or prevent transmission of infectious diseases and be knowledgeable of its potential risk to the client and hospital staffs. There is a great need to assess and evaluate their knowledge regarding infection control on a periodic or timely basis. More than this, need of the hour is to assess their practices regarding implementation of gained knowledge. [8].

Guidelines about infection control measures are one of the strategies that have used to prevent the spread of infectious diseases. Nursing student should be able to do the caring of patients after learning the principles of standard precaution, effective training is essential to ensure that these concepts about standard precautions are understood and put into practice wherever health care is provided [9]. Nurse is expected to perform all functions necessary for the total care of the patients [10].

Standard precautions are a set of guidelines designed to reduce the risk of acquiring occupational infection from both known and unexpected sources in the healthcare care workers compliance [11]. Other reported factors that contribute to non-compliance with the standard precautions include lack of understanding and knowledge among health care workers on how to properly use protective barriers, lack of time, lack of resources and lack of proper training [12]. The nurse should be knowledgeable about the types of infections seen most often, factors that predispose a patient to a nosocomial infection, how to recognize persons at risk of infection, and the prevention and control measures necessary to decrease the incidence of nosocomial infections [13].

Despite the fact that such educational programs could enhance nurses' compliance with hand hygiene practices. Compliance with infection prevention practices and knowledge of infection prevention, there is a lack of research studies focusing on educating nursing students on infection prevention precautions. In nursing schools, infection prevention precautions are not taught in special courses. Instead, most nursing schools include the topic as a 1-hour lecture within the clinical course, which may be insufficient. As a developing country, there was a limited resource, carrying implications for the control of nosocomial infections making infection prevention programs of the utmost importance. This is intended to serve as a platform for highlighting the importance of infection prevention [14]. So nurses should have the opportunity to practice infection control on a day-to-day basis as an integral part of patients' care [1].

Therefore, nurses should have professional and ethical responsibilities to make sure that their knowledge and skills regarding infection control are up-to-date and they practice safely and competently at all times [13]. Thus, education about infection prevention and control was targeted as one of the main objectives of the infection control programs especially where nurses represent the largest group of workers within the healthcare system [15 & 16].

II. Significance of the problem:

Little is known about nursing students' experiences of infection control in the clinical setting despite its importance protecting patients and reducing risks of occupational exposure. A Study regarding nosocomial respiratory infections and nurses' performance related to infection control measures was conducted in artificially ventilated patients in Egypt to assess nurses' practices regarding daily care activities, ventilator decontamination, use of universal infection control measures and the maintenance of the patients' care environment. The study revealed a high incidence of nosocomial respiratory infections. Also, it was revealed that pseudomonas was the causative agents in more than one fourth of the cases. Moreover, nurses' infection control practices were inadequate [17]. Therefore, the purpose of the present research is to study and analyze knowledge, attitude and performance towards infection control measures among nursing students and to explore the effect of educational intervention on their knowledge, performance and attitude in order to protect themselves and others from infection transmission [13]

III. Aim of the study:

The aim of the study was to measure the effect of nursing guide line on compliance of medical surgical nursing students regarding infection control measures at faculty of nursing Menofia University through the following:

1- Assessment of knowledge, practice and attitude of medical surgical students at faculty of nursing Menofia University related to infection prevention precautions measures
2- Explore the nursing guideline regarding infection control and its measures on the knowledge, practice and attitude of medical surgical students at faculty of nursing menofia university
3- To determine the barriers of compliance with infection prevention precautions measures as perceived by medical surgical nursing students at faculty of nursing Menofia University

Study hypotheses:

1- The study group subjects who exposed to nursing guideline exhibits more mean knowledge score compared to the control group subjects who do not exposed.

2- The study group subjects who exposed to nursing guideline exhibits satisfied practice, attitude compared to the control group subjects who do not exposed.

3- The study group subjects who exposed to nursing guideline exhibits more compliance compared to the control group subjects who do not exposed.

IV. Subjects and Methods

Research Design: This study used Quasi-experimental research design with pre, post and follow up was used to achieve the aim of the study.

Setting: The study was carried out at university hospital during training of nursing students, Menofia University.

Study Subjects: A sample of 100 students at second year academic medical surgical nursing students at faculty of nursing Menofia University. Participants were assigned randomly and alternatively into 2 equal groups 50 in each group.

A- Control group I: don't know the educational intervention

B-Study group II: exposed to the educational intervention.

Tools for data collection:

Three tools were used to collect the data for this study.

Tool I –Medical Surgical Nursing Student's Knowledge Regarding Infection Control Measures Structured Questionnaire Sheet: Proper questionnaire was used as a tool for data collection in both pre, post and follow up test of the infection prevention control measures, in order to measure the knowledge level of the medical surgical nursing students about infection control measures, the questionnaire consisted of two parts;

- **Part (1);** this questionnaire covered the demographic characteristics of medial surgical nursing students to describe the study sample as age, gender, clinical area of training, presence of infection prevention control guideline manual, presence of infection prevention control nurse, factors impending proper infection control practice as evidenced by students.
- **Part (2);** the knowledge questionnaires sheet adopted from [(18)] **Yashpreetsingh** are formulated to gather data about; process of infection that contains twenty items. prevention and control of infection contain three items (1,2,3) hand hygiene contains five items (8,9,10,11,15), Personal protective equipment (gloves, mask, gown) that contain seven items (7,12,13,14,16,17,18), isolation precaution that contain five items (4,5,6,19,20) all (20 items).

Scoring system:

The correct answer was given a score of one and the incorrect a score of zero. Total score was ranged from 0-20. Those who scored below 10 had poor knowledge, those who scored 10 to 14 had fair knowledge and those who scored 15 to 20 had good knowledge

Tool II – performance Observational check list related to infection control measure; Observational checklist was developed for assessing student nursing performance at the most common performed procedures at training clinical areas this tool was used before and after the guidelines to evaluate the extent to which the training guidelines affected nurses performance. Observation checklist included seven procedures related to infection control, that (hand hygiene contain 7 items, personal protective equipment contain 15 items (gloves, mask, gown), handling sharp instrument contains 7items, safe injection practice contain 9 items, caring of wound dressing contain 8 items, IM injection contain 7 items and giving intravenous infusion contain 10 items). It was done during routine work.

Scoring system of students' performance: Total score of performance test was ranged from 0- 63. One mark was given for done and zero for not done. It was distributed as follow: (hand hygiene 7 score, personal protective equipment 15 score (gloves, mask, gown), handling sharp instrument 7 score, safe injection practice 9 score, caring of wound dressing 8 score, IM injection 7 score, and giving intravenous infusion 10 score).

Tool III –Attitude related to infection control measure scale; it was adapted from **Al Yousef S A, (2014)**. It includes 13 questions related to opinion of medical surgical nursing students regarding infection control and its measures. It scored as follow: Strongly agree = 3, Uncertain = 2, Disagree = 1, the questionnaires were tested for its content validity and relevance by a jury of five expertises in different fields of nursing at Faculty of Nursing menofia university. The experts' responses were represented in four points rating score ranging from (4-1); 4= strongly relevant, 3= relevant, 2= little relevant, and 1= not relevant. A few changes were made for a few unclear words the researcher considered attitude score less than 60% negative attitude ,60% and more positive attitude .

Validity and reliability of the tool:

The tool was developed by the researchers after reviewing of the related literature and tested for its content validity. Validity indicated the degree to which the tool measures what it is expected to measure. The questionnaire validity was determined by a panel of three experts. Modifications were carried out according to the panel judgment on clarity of the sentences and appropriateness of the contents. Reliability of the tool was established through test re-test method at a 15-day interval with a group of 15 nursing students not participating in the study. Chronbach's alpha was applied for the reliability of the questionnaire and was found to be 0.74.

Field work: Data collection for this study was carried out from the first of February 2015 to end of March 2015. Once permission was granted to conduct the study, the researchers were initiated collection.

- Before distributing the questionnaire the researchers introduced themselves and a brief explanation about the objective of the study was given to the nursing students. Questionnaires were distributed to the selected students who agree to participate in the study. The researchers were presented during data collection to make any required clarifications about questionnaires to the subjects.
- The average time taken for completing questionnaires was around 20-25 minutes. After completion of the questionnaires, the researchers collect it and make sure that questionnaires were being filled fully
- After collection of the data from both groups (pre test), the intervention was carried out of the study group, students were divided into two groups; each group consisted of 50 students and attended four sessions and the duration of each session was 30- 45 minutes.
- All study subjects received the three tools sheet to estimate pre-test assessment for knowledge, performance and attitude.
- Once the approval was taken to carry out the study, the researchers started to collect data and implement the program of intervention in the following way:

  A-All study subjects received the three tools sheet to estimate pre-test assessment for knowledge, performance and attitude.

  b- Nursing students are given booklet about infection control guidelines. Training sessions were conducted by the researchers which are divided into 4 sessions; 1 hours per day (1 day for week) for (4) weeks.

  c- Knowledge assessment sheet filled by the nursing students for pretest and post test within 30 minutes.

  E-Observational checklist for assessing nursing students' performance was filled by the researchers within 30 minutes during the students working in the hospital.

  F-Attitude sheet was filled by nursing students to show their attitude related to infection control and its measures within 30 minutes.

-The methods of teaching used in the program were lectures, group discussions, and posters demonstration of health practice.

Standard precaution guidelines sessions (4 sessions).

1-The first session was geared knowledge content about infection, infection control, hand washing, personal protective measures and handling sharp instruments. It was given in about (1) hours.

2- The second session was geared toward clinical application of hand washing, personal protective measures and dealing with sharp instruments. It was given in about (1) hours.

3-The third session was geared knowledge related to; environmental hygiene, precautions against blood borne transmission and prevention of respiratory infection. It was given in about (1) hours.

4-The fourth session was toward clinical application of environmental hygiene, toward clinical application of dealing with sharp instruments, caring of wound dressing, IM injection and giving intravenous infusion), It was given in about (1) hours.

Evaluation phase: every participant's of students were evaluated three times during the research period using three tools , pre intervention, after two weeks post intervention and follow up after 4 weeks.

Pilot study:

A pilot study was carried out on 10% of nursing students to assess clarity and applicability of the tool and estimate the time needed to fill each part. The necessary modification was done as revealed from the pilot study. The sample of the pilot study was excluded from the total sample to assure the stability of the result.

Administrative and ethical consideration:

Written approval was obtained from the deans of the nursing colleges to collect data from the students, they were informed that they had the right to accept of refuse to participate in the study and that their information will be used for the purpose of research only.

The study was conducted with careful attention to ethical standards of research and the rights of the participants.

- Informed consent: The respondents' rights was protected by ensuring voluntary participation; so that informed consent was obtained by explaining the purpose, nature, time of conducting the study, potential benefits of the study and how data will be collected.
- Anonymity and Confidentiality: The respondents were assured that the data will be treated as strictly confidential; furthermore, the respondents' anonymity was maintained as they weren't required to mention their names.

Estimated Sample Size

Based on previous studies examining the effect of educational interventions on nursing students' infection prevention knowledge, attitudes, and compliance, a conservative effect size of 0.35 was estimated.29, 30 Using the statistical software G*Power V.331 at a statistical power of 0.80, effect size 0.35, and statistical significance 0.05, the estimated sample size required to perform 2- sample t tests was 100 subjects (50 subjects in the experimental group and 50 in the control group).

Statistical analysis:

Methods of data analysis: All data were collected, coded, tabulated and subjected to statistical analysis. Statistical analysis is performed by statistical Package SPSS in general (version 13), also Microsoft office Excel is used for data handling and graphical presentation. Quantitative variables are described by the Mean, Standard Deviation (SD), while qualitative categorical variables are described by proportions and percentages. Descriptive statistics are used to analyze the response to individual items and the respondents' characteristics. Chi-square and P- value test used to test correlation.

V. Results

The results of the present paper will be presented in five main parts as the following:

Part I: Biosociodemographic characteristics of both groups (table 1).
Part II: Factors impeding proper infection prevention precaution practice (table 2).
Part III: Knowledge assessment and evaluation of both groups before and post teaching (table 3 and 4).
Part IV: Attitude assessment and evaluation of both groups before and post teaching (table 5 and 6).
Part V: Compliance with infection prevention precaution (table 7)

Table (1) shows distribution of students of both groups according to their sociodemographic characteristics. It was revealed that the mean age for study group was 18.96±1.61 years and 19.10±1.07 years for control group. More than half of study and control groups (68 % and 76 % respectively) were female. In relation to previous training about infection prevention precaution**,** the majority of both study and control groups (86% and 80 % respectively) weren't previously trained. There was no statistically significance differences between both groups related to all sociodemographic characteristics.

Table (2) reveals distribution of students of both groups according to factors impeding proper infection prevention precaution practice. It was observed that about half of study and control groups (44,00 % and 50,00% respectively) indicating that lack of knowledge is the most common factor impeding proper infection prevention precaution practice. There was no statistically significance differences between both groups related to their opinion about all factors impeding proper infection prevention precaution practice.

Table (3) illustrates distribution of students of both groups according to their knowledge about infection prevention precaution pre and post teaching by two and four weeks. It was noticed that, before teaching, about half of both study and control groups (50% and 40% respectively) had poor total knowledge score. After teaching more than half of study group (56%) had good total knowledge score than 46% of control group whose obtain poor total knowledge score .There were no statistically significance differences between both groups related to total knowledge score but post teaching, there were statistically highly significance improvements in total knowledge score for study group than control group. This table support hypothesis number two.

Table 4: This table shows that, among study group, there is a highly significant improvement in the knowledge after education (both post and follow up) than before education (P-value <0.001). However, for the control group, there is no significant improvement is observed as the level of knowledge remains more or less the same throughout the study period (P-value >0.05).

Table 5: This table shows that there is highly significant improvement in positive attitude among study group than control group after teaching in post and follow up periods (P-value<0.001), however there in non-

significant difference regarding attitude was observed between two groups before applying the teaching program (P=value>0.05).

Table 6: This table shows that, among study group, there is a highly significant improvement in positive attitude after education (both post and follow up) than before education (P-value <0.001). However, for the control group, there is no significant improvement is observed as the attitude score remains more or less the same throughout the study period (P-value >0.05).

Table 7: This table shows that the mean value of all infection control measures in the observation checklist are significantly higher among study group than control group (P-value<0.001). It was revealed that, there was high statistically significance differences between both groups related to all procedure's observational checklist. This table support hypothesis number three.

Table 8: This table show there was significant improvement in compliance with infection prevention precaution from before teaching than post teaching and follows up in study group than control group.

Table 9: This table shows significant positive correlation between knowledge regarding infection prevention precautions and its compliance among study group in both post and follow up teaching (P-value<0.001). It means that after teaching, with increasing the knowledge the compliance significantly increases.

Table 10: This table shows that with increasing good attitude after teaching (both post and follow up), the compliance significantly increases (P-value <0.05).

VI. Discussion about infection control

Infection control is a key component of practice for all healthcare professionals including nursing students, not only for their health but also to reduce infections transmission and thus improve the patient safety [(20).]

The present study showed that the majority of both groups weren't trained previously on infection prevention precautions. Supporting this result **Fashafsheh,et al.,** [(21)] who evaluated the knowledge and practice of nursing staff towards infection control measures revealed that approximately one quarter of the respondents were with poor knowledge that may be due to lack of infection control training courses. The researchers explained this result due to the similarity of nursing courses in most of universities.

Regarding to barrier of infection control precaution, the present study revealed that most of study and control group indicated the common barriers to comply with infection control precaution as lack of knowledge then lack of equipments. This result was supported by **Abdulraheem et al.,** [(22)] who observed that half of the health workers had no knowledge of universal precautions. At the same line **Sax et al.,** [(23)] **who** reported that lack of knowledge is the major reason for non adherence to standard and isolation precautions. Also **Luo et al.,** [(19)] **who** found that only half had knowledge and half had lack of knowledge of all the standard precautions. **Abou El-Enein & El Mahdy** [(24)] found poor knowledge level among slightly less than half of nurses who indicated that they heard about standard precautions. Also **Lopez** [(25)] reported a high degree of confusion and a lack of knowledge regarding standard precautions. These findings are consistent with the findings of a study done by **Jain & Dogra** [(26)] which indicated that less than half of the participants used caps, masks, and gowns as part of maximal barrier precautions. Furthermore **Ahmad, et al.,** [(27)] supported those results. They found the barriers of infection control precaution were the lack of nurses' knowledge and lack of disposable supplies. **Adly, et al.,** [(28)] illustrate the most frequently reported barriers for applying standard precautions of infection control were inadequate equipment, limited number of nurses in the unit, ineffectiveness of the precautions and insufficient time. From the researchers' point of view, the similarity of results may be due to the majority of the researches were conducted in the Middle East, which is characterized by similarity resources, personality traits, and behaviors.

Regarding to knowledge and total score of knowledge the current study showed that there was highly significant improvement of knowledge among study group than control group after teaching in post and follow up periods, This result was in agreement with **Abouelhamd** [(29)] who found that higher level of knowledge was revealed in the post intervention phase as compared with the pre intervention phase. Also higher total knowledge and attitude scores were revealed in the post intervention phase as compared with the pre intervention. On the same line **Stephenie** [(30)] who study The effectiveness of educational programs to improve the knowledge and compliance of healthcare workers towards standard precautions, found that when measuring the knowledge levels of occupational exposures and universal precautions, the higher the score, the higher the level of participants' knowledge after receiving the intervention. Furthermore **Al Yousef** [(10)] revealed that nursing student reported statistical significant post guidelines improvement in their knowledge about all general measures of infection control include hand hygiene, personal protective equipment. Also he revealed that the majority of the nursing students had significant improvement in total knowledge (general & specific) post guidelines from moderate level to good level. **Adly, et al.,** [(28)] who found there was a statistical significant difference before, immediately after the intervention and at follow up. Nurses had a satisfactory knowledge about the aim and the indications of

standard precautions immediately after the intervention compared at follow-up respectively. The researchers explained that because of intervention refresh participant's knowledge that has a positive effect.

Regarding to attitude before, post and follow up teaching about infection control the current found that there was highly significant improvement as positive attitude among study group than control group after teaching in post and follow up periods, also among study group, there was a highly positive attitude after education (both post and follow up) than before education compared with control group. Al **Yousef** [(10)] supported the results. He showed that overall of nursing students had positive attitude toward infection control and its measures post program. Also **Sessa et al.,** [(31)] support the present study finding and showed that the respondents had an extremely positive attitude toward the utility of guidelines and protocol for infection control procedures. **Singh and Purohit** [(32)] who assessed Knowledge, attitude and practice towards infection control Measures; found that the respondents had a positive attitude toward infection control measures. Furthermore **Wang et al.** [(33)] revealed that the training and education have been found to be of paramount importance to developing awareness among health care workers, as well as improving adherence to good clinical practice. The researchers explained that because of there was positive relation between knowledge that lead to improving awareness and attitude.

Regarding to student's compliance with infection prevention precaution, Present study results showed that the majority of nursing students demonstrated significantly higher improvement in performance score and total performances among study group than control group post and follow up intervention regarding general measures of infection control standard precautions includes hand hygiene, personal protective equipments, handling sharp instruments, Safe injection practice, caring of wound dressing, IM injection and giving intravenous infusion than pre intervention. **Al-Hussami and Darawad** [(17)] and **Rosenthal et al.,** [(34)] who evaluated compliance of nursing students with infection prevention precautions found that the educational programs about the infection control precautions are significantly influenced the participants' performance. Also they found that the effect of education and performance feedback on specific infection control measures were effective after training program. Additionally they showed that the causes of low level of pre guidelines performance might be due to inadequate training for infection control measures, inadequate supply of personal protective equipments and carelessness of students. On the same line **Adly, et al.,** [(28)] said that there was an improvement immediately after the intervention and, at follow-up. While, high significant statistical differences were found in relation to hand washing, gowning, gloving and masking respectively. From researchers' point of view, this may be due to the positive effect of educational intervention of performance and attitude.

Present study showed that the majority of the nursing student's had significant improvement in total performance post and follow up guidelines than pre intervention. It was possible to verify greater compliance among nurses regarding the practice of infection control measures. The results of this study agreed with the results of **Abela& Borg** [(35)] who illustrate that visual material such as posters had to be combined with educational sessions for the staff to impact positively on the compliance to hygiene routines. This is supported by **Mamhidir et al.,** [(36)] who mean that having information and knowledge about infection transmission is leading to a higher compliance with hygiene practice and routines. In other study **Moftah et al.,** [(37)] who found that the majority of the nurses did not carry out or perform certain procedures in relation to infection control precaution in health care centers such as use of protective barriers e.g., gloves, mask, apron and correct disposal of needles and sharp instruments thus, it can be argued that suggested training program is effective in improving nurses' knowledge and practice regarding infection.

The present study illustrated that significant positive correlation between knowledge regarding infection prevention precautions and its compliance among study group in both post and follow up teaching (P-value<0.001). **Rickard** [(38)] stated that to improve compliance, "one must make cultural changes which makes it easier for health care workers to comply by improving hospitals and their materials and have health care workers to provide feedback on infection rates and areas that should be targeted. **Adly, et al.,** [(28)] indicated that the nurses had a higher score of knowledge, practices and compliance with standard precautions of infection control immediately after the intervention while, this improvement reflected a highly statistically significant difference.

The present study revealed that with increasing positive attitude after teaching (both post and follow up), the compliance significantly increases (P-value <0.05). This results supported by **Khaled et al.,** [(39)] concluded that compliance to hand washing was low. Implementation of multifaceted interventional behavioral hand hygiene program with continuous monitoring and performance feedback, increase supplies necessary for hand hygiene and institutional support is important for improving the compliance of hand hygiene guidelines. This finding was in agreement with **Duerink** [(40)] who found reported significant positive correlations between knowledge, attitude, self reported behavior and perceived obstacles The greater healthcare workers' knowledge, the more they showed the preferred attitude, the more obstacles they perceived and the better their self-reported behavior.

So study results support the finding that application of nursing guidelines are effective for improving knowledge, practice and attitude of student nurses in any health care settings. Therefore, hospital administrators

should provide support and resources in the form of education and training opportunities designed to increase the health care personnel awareness and application of infection control procedures.

VII. Conclusion:

Based on the results of the present study it can be concluded that, the research hypothesis is accepted while it was found that, the intervention of the study significantly improves the nurses' compliance with standard precautions of infection control by increasing their knowledge and practices.

The majority of student nurses experienced lack in their knowledge and practices regarding universal precaution of infection control and this lack was corrected after implementation of the educational intervention, the most frequent causes behind these defects was due to lack of training of infection control precautions

VIII. Recommendations:

Periodic refreshing training courses should be provided in order to keep the student nurses of updating knowledge and practices regarding universal infection control precautions.

- Availability of all facilities and equipments required for applying standard precautions of infection control.

-Availability and accessibility of written guidelines in the hospital and unit polices related to standard precautions for infection control.

-Emphasizing on the importance of continuing in service education for nurses by using the evidence based practices for application of standard precautions of infection control.

-Follow up the nurses' compliance/ performance/ utilization of standard precautions of infection control by the infection control team.

-Providing orientation programs for newly employed nurses about standard precautions infection control. Availability of posters for reminding nurses to comply with standard precautions.

Part 1: **Biosociodemographic characteristics of both groups (table 1).**

Table (1): Distribution of students of both groups according to their sociodemographic characteristics.

Sociodemographic characteristics	**Studied groups**				χ^2	**P value**
	Study group N=50		**Control group N=50**			
	No.	**%**	**No.**	**%**		
Age (years):						
• Mean±SD	18.96±1.61		19.10±1.07		0.51*	0.61**
• Range	18.00 –20.00		18.00–21.00			
Gender :						
• Male	16	32.0	12	24.0	0.79	037**
• Female	34	68.0	38	76.0		
Clinical area of training:						
• Trauma	9	18.0	8	16.0		
• ICU	10	20.0	9	18.0	7.38	0.19**
• Internal medicine	11	22.0	7	14.0		
• Surgery	10	20.0	6	12.0		
• Emergency	10	20.0	16	32.0		
• Oncology	0	0.0	4	8.0		
Training about infection control:					0.64	0.42**
• Yes:	7	14.0	10	20.0		
• No:	43	86.0	40	80.0		
Presence of infection control nurse:						
• Yes:						
• No:	7	14.0	10	20.0	0.64	0.42**
	43	86.0	40	80.0		
Length of training on infection control measures:						
• One day						
• Two days	3	42.9	8	80.0		
• 3 days	4	57.1	2	20.0	2.49	0.1**
• More	0	0.0	0	0.0		
	0	0.0	0	0.0		

(*) Student's t test

(**) Non significant results (P-value > 0.05)

Part II: Factors impeding proper infection prevention precaution practice (table 2).

Table (2): Distribution of students of both groups according to Factors impeding proper infection prevention precaution practice (not complying).

Factors	Studied groups				χ^2 test	P value
	Study group N=50		Control group N=50			
	No.	%	No.	%		
Lack of knowledge	22	44.0	25	50.0	0.16	0.69
Lack of time	4	8.0	7	14.0	0.45	0.5
Lack of equipment	12	24.0	13	26.0	0.05	0.82
Forgetfulness	11	22.0	2	4.0	5.66	0.02*
Lack of leadership	1	2.0	3	6.0	0.26	0.61

(**) Non significant results (P-value > 0.05)

Part III: Knowledge assessment and evaluation of both groups before and post teaching (table 3 and 4).

Table (3): Distribution of students of both groups according to their knowledge about infection prevention precaution pre and post teaching by two and four weeks.

Items	Before teaching				Post teaching				Follow up			
	Study group N =50		Control group N =50		Study group N =50		Control group N =50		Study group		Control group	
	No.	%	No.	%	No.	%	No.	%	No	%	No	%
Total score level:												
• Poor (< 50%)	25	50.0	20	40.0	7	14.0	23	46.0	9	18	24	48
• Fair (50-< 80%)	19	38.0	18	36.0	15	30.0	14	28.0	18	36	16	32
• Good (≥ 80 %)	6	12.0	12	24.0	28	56.0	13	26.0	23	46	10	20
X^2 test	2.58				14.06*				12.06*			
P Value	0.27				<0.001				<0.001			
Total student's knowledge score												
Total score of knowledge : Mean±SD	10.18±1.84		10.54±0.61		15.84±0.74		10.76±1.27		14.92±1.06		10.48±0.98	
Student t test	1.31				24.44*				21.28*			
P Value	0.19				<0.001				<0.001			

Table (4): Distribution of students of both groups according to their total knowledge score before and post teaching by two and four weeks.

Items	Study group						Control group					
	Pre test N =50		Post test N =50		Follow up		Pretest N =50		Post test N =50		Follow up	
	No.	%	No.	%	No	%	No.	%	No.	%	No	%
Score level:												
Poor (< 50%)	25	50.0	7	14.0	9	18	20	40.0	23	46.0	24	48
Fair (50-< 80%)	19	38.0	15	30.0	18	36	18	36.0	14	28.0	16	32
Good (≥ 80 %)	6	12.0	28	56.0	23	46	12	24.0	13	26.0	10	20
X^2	28.74*						1.29					
P Value	<0.001						0.86					
	Total student's knowledge score											
Total score of knowledge : Mean±SD	10.18±1.84		15.84±1.74		14.92±1.06		10.54±0.61		10.76±1.27		10.48±0.98	
ANOVA test	36.15						2.69					
P Value	P1<0.001, P2<0.001, P3=0.07						P1=0.31, P2=0.27, P3=0.23					

(*) significant result

P1 between pre & post, P2 between pre & follow up, P3 between post & follow up

Part IV: Attitude assessment and evaluation of both groups before and post teaching (table 5 and 6).

Table (5): Distribution of students of both groups according to their total attitude score pre and post teaching by two and four weeks.

Items	Before teaching				Post teaching				Follow up			
	Study group N =50		Control group N =50		Study group N =50		Control group N =50		Study group		Control group	
	No.	%	No.	%	No.	%	No.	%				
Score level:												
Positive (13-26)	12	24.0	11	22.0	41	82.0	14	28.0	38	76	13	30
Negative (< 13)	38	76.0	39	78.0	9	18.0	36	72.0	12	24	37	70
χ^2 Test	0.06				29.46				21.24*			
P Value	0.81				<0.001				<0.001			
Total student's knowledge score (26)												
Total score : Mean±SD	19.76±2.67		19.54±1.89		25.08±3.36		20.50±3.88		24.3±2.89		19.4±3.54	
Student t test	0.48				6.31*				7.58*			
	0.63				<0.001				<0.001			

Table (6): Distribution of students of both groups according to their total attitude before and post teaching by two and four weeks.

Items	Study group						Control group					
	Pre test N =50		Post test N =50		Follow up		Pretest N =50		Post test N =50		Follow up	
	No.	%	No.	%	No	%	No.	%	No.	%	No	%
Score level:												
Positive (13-26)	12	24.0	41	82.0	38	76	11	22.0	14	28.0	13	26
Negative (< 13)	38	76.0	9	18.0	12	24	39	78.0	36	72.0	37	74
χ^2 Test	42.63*						0.49					
P Value	<0.001						0.78					
Total student's attitude score												
Total score : Mean±SD	19.76±2.67		25.08±3.36		24.3±2.89		19.54±1.89		20.50±3.88		19.4±3.54	
ANOVA test	37.26						1.39					
P Value	P1<0.001, P2<0.001, P3=0.24						P1=0.12, P2=0.08, P3=0.1					

*significant

P1 between pre & post, P2 between pre & follow up, P3 between post & follow up.

Table (7): Means and standard deviations of student's compliance with infection prevention precaution

Infection control measures Observation checklist	**Studied groups at post-test**		**Student's t test**	**P value**
	Study group N=50	**Control group N=50**		
	Mean±SD	**Mean±SD**		
Hand Hygiene	3.74±0.53	2.70±0.51	10.00*	<0.001
Personal Protective Equipment (gloves &gown &mask)	5.92±0.99	3.71±0.73	12.70*	<0.001
Handling Sharp instrument	3.98±0.84	2.78±0.61	8.17*	<0.001
Safe injection practice	5.72±0.97	3.62±0.92	11.11*	<0.001
Caring of wound dressing	6.14±0.88	4.33±0.72	11.26*	<0.001
IM injection	3.54±0.92	2.84±0.66	4.37*	<0.001
Giving intravenous infusion	5.42±1.24	3.54±1.09	8.058	<0.001
Total	33.14±2.76	21.39±3.70	18.00*	<0.001

*significant

Table (8): Means and standard deviations of student's compliance with infection prevention precaution

Infection control measures Observation checklist	Before teaching		Post teaching		Follow up	
	Study group N =50	Control group N =50	Study group N =50	Control group N =50	Study group	Control group
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Total score	19.87±2.21	20.08±2.07	33.14±2.76	21.39±3.70	31.51±2.34	20.94±3.41
Student's test	0.49		17.99*		18.07*	
P Value	0.31		<0.001		<0.001	

Table (9): Correlation between knowledge after teaching (post and follow up) and infection prevention precaution compliance for study group.

Variable	Knowledge post teaching		Knowledge follow up teaching	
	R	P value	r	P-value
Total score of compliance	0.37	0.007*	0.36	0.008*

= Pearson correlation coefficient

Table (10): Correlation between attitude after teaching (post and follow up) and infection prevention precaution compliance among study group.

Variable	Attitude post teaching		Attitude follow up teaching	
	R	P value	r	P-value
Total score of compliance	0.33	0.02*	0.31	0.03

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