Effect of A Designing Nursing Infection Control Protocol on Operating Room Nurses Performance, A Comparative Study

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Abstract
Background: The nurses are the most important member of the medical team responsible for protecting patients from infection inside the operating room. Therefore, nurses must have great knowledge and strict adherence to infection control measures. **Aims:** To assess the effect of a designing nursing infection control protocol on operating room nurses performance. **Design:** Pre and post-test quasi- experimental design utilize in this study. **Setting:** The study conducted in the operating room at three hospitals: main university hospital (general surgery operation), Urology and Woman Health University Hospital. **Subject** all nurses (60) working in the operating room at the selected setting in the three university hospitals with at list one year of experience. **Results:** There was a significant improvement in the mean and standard deviation among nurses' knowledge in the three university hospitals after the application of the designed nursing protocol with (p=0.001). **Conclusion:** The study findings revealed that level of nurses' knowledge regarding infection control measures improved after the application of the design nursing protocol. **Recommendations:** Nurses should have continuous education through programs, workshops, seminars and/or training courses to maintain high quality care.

Keywords: Infection Control, Operating Room &Nursing Protocol.

Introduction:
Infection control is required in all health care settings. Control over infections requires a basic understanding of disease epidemiology; the risk factor that increases the patient's susceptibility to infection **(Centers for Disease control, 2017).**

Infection control practices are the foundation of a nurse's career. Nurses have a unique opportunity to reduce hospital-acquired infections by utilizing their skills and knowledge of infection control measures in the operating room. This allows them to facilitate patient recovery while minimizing infection-related complications **(Wilson & Miles, 2016)**.

The literature suggests that strong educational protocols about infection prevention and control should be implemented in both academic and clinical settings. These protocols must be an essential part of their job, as they will spend most of their clinical years in healthcare facilities, where they will learn the majority of their skills **(De Bono et al, 2014)**

Surgical site infections (SSIs) are one of the most common causes of nosocomial infections, accounting for 20% of all cases. About 25% of all nosocomial infections worldwide, also 2–5% of all patients undergoing surgical intervention will develop an SSI, and patients will suffer from SSI twice as likely to die as other postoperative patients due to such complications **(Newman et al, 2015).**

The rate of surgical incision infections is unquestionably influenced by hospital operation room management, and a nursing management protocol successfully reduces the hospital acquired infection rate. **(Aorn, 2014)**.

The operating room is a high – risk environment, but the factors contributing to medical errors in this context remain unknown. Because of new advances in technology, instrumentation, or procedures, the operating department environment is constantly changing. This rapidly changing technological environment imposes new educational requirements in practicing the professionals' skills. **(William 2014)**.

Working in the Operating Room (OR) necessitates highly skilled personnel who can coordinate and deliver the care required to patients with surgical intervention, to be able to safely perform the surgical procedures as the OR staff works in an intense, fast-paced, detail-oriented, and technologically advanced environment. Application of effective infection prevention and control measures are essential in the perioperative setting to ensure that patients undergoing any surgical procedure receive safe and quality care **(Sodhi, 2016).**

Safe working practices are also required to ensure the safety of OR team members. The risk of exposure to blood borne pathogens and toxic chemicals is a major concern for OR personnel. In response to these risks,

there should be a focus on the impact of the surgical procedure on the perioperative team, as well as how to keep the surgical team from becoming infected while providing care to the patient undergoing surgical intervention. This continuing education activity investigates the factors that must be considered in order to prevent staff-related infections **(Eramo, 2016).**

The operating room nurse's job should be done on knowledge-based that required the nurses to apply the best available knowledge, clinical experience, within the patient's preferences. To ensure professionally safe practice of the discipline, all related advance resources must be employed **(Yazdankhah, 2015).**

Operating room nurses assist surgeons during operations, as well as prepare patients for surgery and care for them afterward. These nurses oversee a large portion of the communication and education needed for patients with surgical intervention and their families, as well as ensuring that the patient receives the best possible care during and after their operation. **(Sorensen, 2016).**

The duties of nurses within the operating room vary by ensuring that all health workers wear personal protective equipment(PPE) that include: a protective cap, the mask ,eye goggles, the long sterile gowns, protective covers on their shoes and the sterile gloves on their hands. As the or staff responsible about maintain the sterile field during the operation and after the operation they should safety removing (PPE), and washing instruments used during operation all of that resulting a positive surgical outcomes. **(Weiser et al, 2016).**

Individuality, periodicity, and improvability all are characterizing the nursing project management plan. Individuality is the intended to analyze and solve a specific case from a group of similar cases. The purpose of periodicity is to summarize and review management work at regular intervals of time (no longer than 1 year). The ability to improve the quality-of-care offer is by creating more scientific and effective management strategies to adapt to the ever-changing environment and evolving needs. **(Cognat, 2015).**

Compliance with infection control and sterile technique principles will prevent nosocomial infections in the operating room, resulting in a shorter hospital stay for the patient and a lower cost for medical aids and hospitals **(Chan et al, 2016).**

Significance of the study:-

According to the results of **Abd Al Rahman, 2015,** study which was done to assess the nurse knowledge and practice regarding infection control in the operating room at main Assiut university and Aleman hospital revealed that (50%) of nurses at Main University hospital had an unsatisfactory level of

practice regarding infection control measures, Based on the results of this study and through the clinical experience of the researcher, he noticed that nurses are not implementing sterilization techniques properly. Nurses are an important target population to determine their level of knowledge and practice regarding infection control in the operating room.

The Aims of this study were:

To assess the effect of a designing nursing infection control protocol on operating room nurses performance, through:

1. Assessing nurses' level of knowledge and practice regarding to infection control measures in operating room
2. Identifying the effect of implementing a designing nursing protocol on nurses ' knowledge and practice regarding infection control measures in the operating room.
3. Comparing between the nurses' level of knowledge and practice regarding to infection control measures application in operating room in the three university hospitals.

Hypothesis:-

To fulfill the aim of the study the following research hypothesis were formulated:

1. The post mean knowledge scores of nurses who will be exposed to a designing nursing protocol will be higher than their pre mean knowledge scores.
2. The post-practice scores of nurses who will be exposed to a designing nursing protocol will be higher than their pre practice score.
3. A positive relationship will be existed between knowledge and practice score obtained by nurses receiving designed nursing protocol.

Subjects and Method:

Research Design: Pre and post-test quasi-experimental research design was utilized.

Setting: The present study was conducted in operating room of three University hospitals:

1. Main university hospital (general surgery operation).
2. Urology university hospital.
3. Woman health university hospital.

Subject:-

All nurses working in the operating room at the selected three hospitals and their years of experience more than one-year, total number was (60) nurses twenty nurses from each hospital and who are willing to participate in this study.

Exclusion criteria:

1. Head nurses
2. Student nurses.

Tools: Two tools were utilized for data collection in this study after reviewing the relevant related literature, these were:

Tool (1): Pre/posttest Nurse's Interview Questionnaire: -It included two parts.

This tool was used prior to implementation of the designed nursing protocol to measure the exact knowledge level of nurses regarding infection control measures in operating room. The same tool was used immediately after the implementation of the designed nursing protocol (immediate post-test). It consists of 2 main parts:

Part I: Demographic data about the nurses such as (age, gender, qualifications, years of experience, number of attendance of training courses about infection control measures in operating room).

Part II: Assess nurses' level of knowledge: this part used to assess nurses' level of knowledge about the infection control measures inside the operating room at the three university hospitals (main, urology, and woman health). It applied twice Pre and post the implementation of the designed nursing protocol. It includes four parts:

Infection control measures, (4 questions).

Personal protective measures (15 questions).

Dealing with sharps instruments (5 questions).

Knowledge about sterilization and disinfection (13 questions).

Scoring System: The total number of questions was 37, for each item one grade was awarded for the correct answer and zero for the incorrect answer. Those who obtained (<70%) were considered having poor level of knowledge. While those; who obtained (≥70%) was considered having satisfactory level of knowledge

Tool (2): Observation checklist:

This tool used to assess nurse's level of practice regarding the application of the infection control measures in operating room. This tool was used twice before and immediately after the implementation of the designed nursing protocol. It consists of the 23 items. It was divided into three phases:

Nurses' role before operation (71 steps).

Nurses' role during operation (65 steps).

Nurses' role post operation (53 steps).

Scoring System: The total score of the observation checklist was 189 marks. Each item in checklist was scored as follow: - two marks for each step that done correct and one degree for each step done incorrect and zero for step that not done.

Procedure:

The study proceeded using the following phases:

The preparatory phase: (Assessment and planning phase): involved the following:-

Assessment phase

Tools have been designed by the researchers after a reviewing of the past and current, national, and international literature using books, articles, periodicals, and magazines to identify the different aspects of the research problem.

Tool's validity and reliability:

Tool's validity was tested through a jury of (5) experts (specialists in the field of medical - surgical nursing) from Assiut University; their opinions were formulated as regards to the tool format layout, consistency, knowledge accuracy, relevance, and competence. Tool's reliability refers to the degree of consistency with which the instrument (the questionnaire) measures the thing it is supposed to be measuring (nurses' knowledge and practice regarding infection control measures in operating room. Reliability of tool was confirmed by Alpha Cronbach test (0.95 and 0.87).

Administrative and Ethical Consideration:

An official approval was obtained from head of operating units in the three university hospitals to get permission to conduct the study. Verbal consent was obtained from each nurse prior to his/her contribution in the present study, after explaining the nature and purposes of the study. Confidentiality and anonymity assured. The researcher emphasized that the participation was voluntary, and the nurses had the right to refuse to participate in the study and can withdraw at any time.

A pilot study:

A pilot study was carried out in one year and conducted on 10% of the sample (6 nurses) to evaluate the applicability and clarity of tool used for data collection. Based on the results of the pilot study, needed refinements and modifications were made. Nurses selected for the pilot study were not included in the main study. This pilot study was conducted two months before collection of data.

Conducting the pretest:

At the first meeting, the researchers identify themselves to provoke the line of verbal communication, explained the nature and aim of the study. The nurses get the pretest.

- At initial interview, the researcher introduced herself to initiate a line of communication.
- Nurses' agreement for voluntary participation was obtained and purpose and nature of the study was explained.
- The researcher obtains the base line data from the nurses using Tool 1 part (I)

- Assessment of nurses' knowledge about infection control measures in the operating room using Tool 1part (II).
- Assessment of the nurses' practice in the operating room regarding the infection control measures using observation checklist (Tool 2) which filled by the researcher.

The pretest was corrected, and the result was analyzed to identify the nurses needs assessment.

Planning phase:
Based on finding of the assessment phase, a designed nursing protocol for infection control measures in operating room was developed by the researcher, after extensive literature review considering nurses' needs and their levels of understanding.

A designed nursing protocol:
The content of the nursing protocol was developed by the researcher after passing through an extensive review of the relevant related literature about infection control measures in the operating room and according to the nurses' identified needs after getting the result of the pretest regarding their level of knowledge and practice.

It was written in Arabic using simple language with illustrations. That included two portions; The first portion under the title of "infection overview" included information about the infection in the subtitles of "What is infection?", "The infection cycle and how to break this cycle?". The second portion in the booklet under the title of "infection control precautions" included information about intraoperative infection control measures in the subtitles of "Nurses' role in before operation", "Nurses' role during operation", "and Nurses' role post operation".

The implementation phase
- A design nursing protocol was given by the researcher.
- Program content was covered over three sessions; each session took from 30 to 40 minutes.
- The number of nurses in each session was different according to the availability of nurses in the shift (3-5nurses).
- The first session covered the information included in the first portion of a designed nursing protocol (Infection overview).
- The 2nd and 3rd covered the practical information about the intraoperative infection control precautions.
- The number of nurses in each session was different according to the availability of nurses in the shift (3-5nurses).
- During the session, each nurse was given a copy of the booklet in clear Arabic language, to help them retain the learned material.

- At the end of each session feedback was received from the Nurses to assess their understanding, and then the researchers explained any difficult points
- Data were collected during the period from 1/6/2019 to 1/6/2020.
- The study was carried out at morning and afternoon shift.

Phase III: The evaluation phase
Evaluate the effectiveness of a designed nursing protocol on nurses' knowledge and practice through reassessing of nurses' knowledge and practice after implementing the designed nursing protocol using tool 1 part I and tool 2 (the same as the pretest)

Statistical design
The statistical package for (SPSS) version (23) was used to analyze data. Descriptive statistics was used for the quantitative data in all questions and the demographic data. Descriptive statistics included: means, standard division, frequencies, percentages, use Pearson Chi –Square (Cross tabulation) between pre, post-test and post-test after 2 weeks knowledge and observational checklist of nurses were done, independent-t test for mean score of checklist and one way a nova test. The level of significance for this study was set at ($p \leq 0.05$) to detect any indication of differences found in the data available.

Results:

Table (1): Comparison between the three hospitals regarding the demographic data of the studied nurses n=60

| Variables	Name of hospitals						P-value
	Urology hospital		Obstetric hospital		General hospital		
	N (20)	%	N (20)	%	N (20)	%	
Age:							
18_<30	18	85.0	8	40.0	0	0.0	001**
30_<40	3	15.0	11	55.0	5	25.0	
40-50	0	0.0	1	5.0	15	75.0	
Gender:							
Male	13	65.0%	0	0.0%	0	0.0%	001**
Female	7	35.0%	20	100%	20	100%	
Level of education:							
Nursing diploma	2	10.0%	12	60.0%	19	95.0%	001**
Nursing institute	18	90.0%	8	40.0%	1	5.0%	
Years of experience:							
Less than 5years	16	80.0%	7	35.0%	0	0.0%	001**
From5-10years	3	15.0%	1	5.0%	1	5.0%	
More than 10 years	1	5.0%	12	60.0%	19	95.0%	
Attending training course regarding infection control	18	90.0%	20	100.0%	20	100.0%	.126
Number of training course:							
One	15	75.0%	9	45.0%	0	0,0%	0.001**
Two	4	20.0%	2	10.0%	0	0.0%	
Three	0	0.0%	5	25.0%	9	45.0%	
Four or more	1	5.0%	4	20.0%	11	55.0%	
Have you been vaccinated?	17	85.0%	13	65.0%	20	100.0%	.012*
Type of vaccine:(hepatitis)	17	85.0%	12	60.0%	20	100.0%	.001**
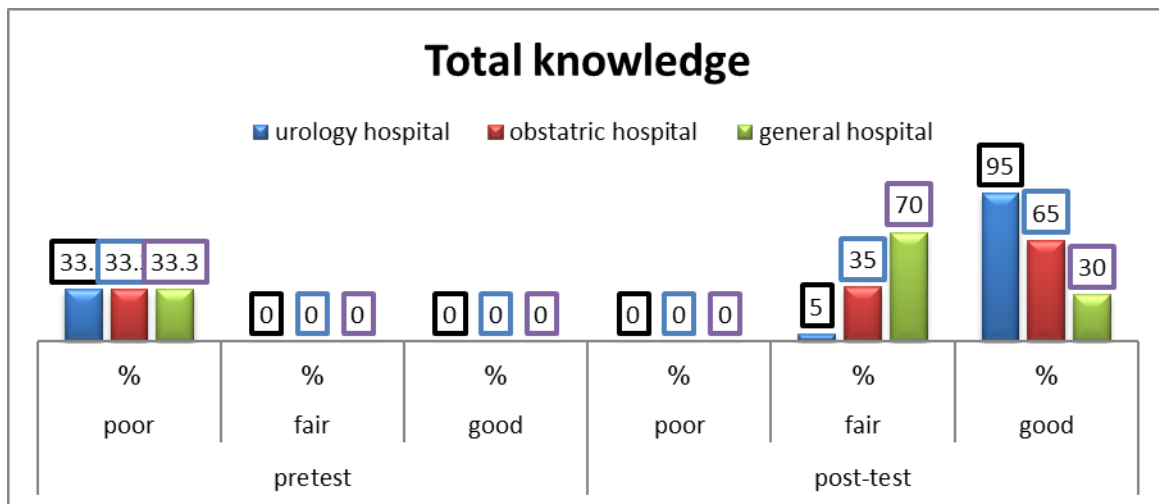
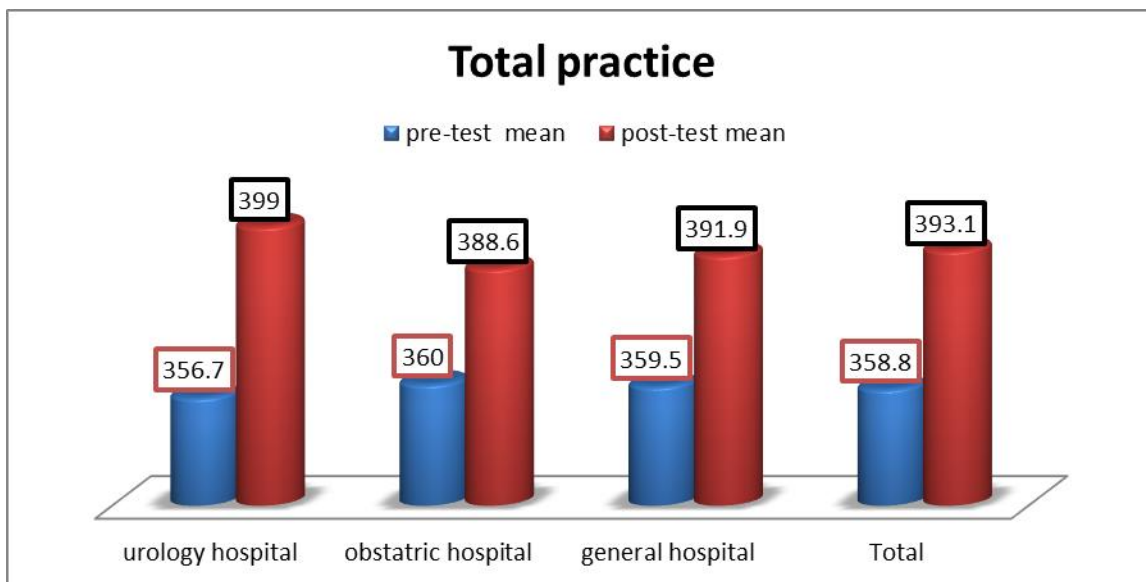**Figure (1): Nurses knowledge pre and post implementing the designed nursing protocol.**

Figure (2): Mean nurses practice pre and post implementing the designed nursing protocol

Table (2): Correlation between the studied nurses' knowledge and their total practice (pre, during and post-operatively).

		Total knowledge level
Total skill	Pearson Correlation	.906**
	Sig. (2-tailed)	.000
	N	120
postoperative	Pearson Correlation	.465**
	Sig. (2-tailed)	.000
	N	120
During	Pearson Correlation	.923**
	Sig. (2-tailed)	.000
	N	120
Total knowledge	Pearson Correlation	1
	Sig. (2-tailed)	
	N	120

*** Correlation is significant at the 0.01 level (2-tailed).*

Table (1): Showed that there was a statistically significance difference between the three hospitals regarding their demographic characters except attending training course regarding infection control. The majority of nurses in the three hospitals were received training course regarding infection control. More than half of the studied nurses receive hepatitis vaccine

Figure (1): Demonstrated that, all nurses in three university hospitals had a good level of knowledge (95%, 65%, 30%) respectively after implementing the designed nursing protocol.

Figure (2): Showed that there were no great differences between the mean nurses' practices about infection control measures in the operating room pre implementing the designed nursing protocol and after implementing the designed nursing protocol in the three university hospitals

Table (2): Reported that there was appositive correlation between the studied nurses' total level of knowledge and their total practice (pre, during and post-operative) after implementing the designed nursing protocol.

Discussion:
Hospital-acquired infection is a worldwide public health issue. As a result, current information and nursing practice can play important roles in infection control. Nurses must be able to perform infection control on a daily basis as an essential part of patient

care, particularly in the operating room. That is why the current study was conducted. The operating room is a specific area of the hospital. This advanced care setting with sophisticated methods poses numerous risks to the patient, including the possibility of infection **(Birgand et al., 2014).**

Nurses have a unique opportunity to reduce hospital acquired infections by utilizing skills and knowledge about infection control measures in an operating room, they can facilitate patient recovery while minimizing complications related to infections **(Sadaf et al., 2018).**

The current study aims to assess the effect of a designing nursing infection control protocol on operating room nurses performance**.**

The current study found that the majority of nurses were aged from 18 to 30 years in the urology hospital, while more than half of the nurses at the Obstetric hospital were aged from 31-40 years, but in the main hospital, three-quarters of the nurses were aged between 41-50 years.

In terms of gender, the majority of nurses in the main and obstetric hospitals were female while in the urology hospital two-third were male. According to their education, the vast majority of nurses in the urology hospital have nursing institute while the nurses in the obstetric and main hospital have a nursing diploma

All of them in the three university hospitals have in-service training courses related to infection control measures.

Nurses' level of knowledge of infection control in the operating room:

The current study revealed that about one-third of nurses in three university hospitals were having poor knowledge score levels as regards infection control measures in the operating room before implementing the designed nursing protocol. This reflects the lack of periodic assessment of the nurses' knowledge. This lack of knowledge may be also due to an increased work load which may hinder nurses' ability to read and update their knowledge. Thus, there was a need to strengthen what nurses know and provide them with the needed knowledge

The present study was in the line with the study conducted by **Birgand et al. (2014**), which identified that staff nurses had knowledge deficit regarding infection control measures in the operating room and nurses needed to receive nursing guidelines in this area.

Also De Bono et al. (2014) conducted a survey of nurses and discovered that only three-quarters of them recognized standard precautions as protective measures.

On the other hand, **Woldegioris et al., (2019)** found that nurses in there studied, had a high level of

awareness about the nursing role regarding infection control application in the operating rooms. The present study also was disagreed with **Zucco et al., (2019) finding in their study as** during the pre-test one third of nurses had inadequate knowledge regarding infection control in the operation room. After the implementation of the intervention the majority of the nurses gained knowledge with (p<0.05)

On the contrary, a study conducted by **Abd Al Rahman (2015)** revealed that nurses had satisfactory level of information about infection control measures in operating room without an intervention.

The current study revealed that all nurses in the three university hospitals had satisfactory level of knowledge about infection control in operating room after implementing the designing nursing protocol. This finding of the present study recommended that periodic refreshment protocols should be planned and implemented for nurses based on their need assessed. This finding was consistent with a study conducted by **Lukose et al., (2014)** and **Patterson, (2017)** who exhibited a statistically significant difference in the overall knowledge scores of the participants between the result of the pre and post-test.

Nurses' practice regarding infection control in the operation room:

The current study found no statistically significant differences in practice before and after implementing the nursing protocol at the three hospitals.

This is consistent with **Jankowski (2017),** who stated that; regarding practices, the pretest results showed that the level of practices significantly increases with the level of education about infection control measures in operating room, but the effects of the educational protocol led to significant correlation in the posttest.

Furthermore, nurses lack the efficiency of updating their practice in the operating room due to the workload and being in the clinical environment for a longer period of time, and one possible explanation for this finding is that the workload is too heavy **(Wong et al., 2020**).

According to **Anderson et al. (2017)**, study a teaching protocols for nursing staff play an important role in assisting staff nurses in developing and enhancing their skills related to operating rooms required to provide high standards of care to their patients. This was supported by the current study, which found that after implementing the designed nursing protocol, nurses' knowledge and practice improved.

Koller et al., (2018), in their study discovered an improvement in nurses' practice after attending continuing nursing education sessions about patients care in the operating room, which is consistent with

the current study findings. According to the findings of the research, continuing nursing education programs improve nurses level of knowledge, practice, and attitudes.

This is consistent with the findings of **Pellegrini et al., (2017)**, who found that healthcare in the operating room, despite precision and mastery skills, is not immune to such errors due to educational system flaws or high workload and pressure, as well as the responsibilities of the nurses, which lead to some errors, which indicating the need for a continuous education protocol.

In this regard, **Privitera et al. (2017)** in their study found some progress in establishing the status by providing a framework for developing clinical guidelines for future practice. Furthermore, they recommended that every nurse, regardless of length of time in operating rooms, experience, or qualifications, receive appropriate training to support these protocols.

Also, **Ralph et al. (2017)** reported that clinical popularization and application of teaching protocols for nursing staff is warranted. This management plan improves specific infection-control measures.

Patient safety has always been a tenet in nursing practice and has become a major priority. Coordination and collaboration at all levels were required to ensure that all patients and healthcare workers were adequately protected **(Wong et al., 2020).**

Elgazzar & Qalawa (2020) discovered that the implementation of infection control strategies during the operation had a significant effect on nurses' practice. The practical conduct of nurses in the operating room, such as disinfection of the operation site and instrument manipulation, which were generally performed by staff or experienced nurses.

According to **Pellegrini et al. (2017),** there is a low tolerance for failed attempts and retries. Procedural training for junior residents took a back seat; the goal was to make a good, clean attempt in the shortest amount of time possible, without jeopardizing the patient's or the healthcare worker's safety.

Furthermore, **Bennett & Jan Rodd (2017)** stated that nurses should begin their education by becoming registered nurses and continue their education by earning a master's degree in operative nursing.

This was in line with **Malik, (2019)** who stated that nurses in the operation room must applied principles and practices of aseptic technique that ensure and maintain a sterile field.

This was in line with **Sonoiki et al., (2020)** who concluded that; to attain the best possible outcome, nursing and medical staff require specialized skills.

The current study reported a statistically significant difference between pre and post-test regarding PPE safety procedures. This finding suggested that skills could be easily improved, particularly when linked to their relevant scientific base of knowledge. This was consistent with the findings of **Elgazzar & Qalawa (2020)**, which discovered that the majority of the study group had a high level of infection control practice in the operating room.

The results of the current study revealed that education is a successful tool in improving level of knowledge and practice of the nurses. These results are congruent with Stein et al., (2016) who stated that education, monitoring, improve the availability of resources and disciplinary measures for poor compliance are necessary to improve the application of infection control measures in hospitals.

Conclusion:

Based on the findings of this study, it is possible to conclude that there has been a significant improvement in the total scores of nurses' level of knowledge. However, there was no statistically significant difference in nurses' practice at the three hospitals (pre, during, and post-operative) regarding the application of infection control measures in the operating room following the application of the design nursing protocol about the infection control measures in the operating room**.**

Recommendations are as follows:

Based on the results of the present study, the following points are recommended:

- Written material about infection control measures in the operating rooms in simple Arabic language should be available for all nurses to be used as an ongoing reference, which well be helpful for nurses' acquisition of knowledge.
- Appling adult learning rules throughout the educational sessions with encouraging the participant to ask questions, participate actively in the discussion, and interactions with the intervention as well as the use of multimedia will improve effectively the impact of the program on nurses ability to gain the information they need.

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