The Effect of Infection Control Training Sessions on Recently Employed Nurses' Knowledge and Performance

[1]Alaa Samir Fathy Abdelrahman, [2]Lamiaa Amin Awad Salama, [3]Asmaa Ahmed Abdallah

[1]Nursing Specialist in Belkas General Hospital
[2]Professor of Community Health Nursing Faculty of Nursing – Mansoura University
[3]Lecturer of Community Health Nursing Faculty of Nursing -Mansoura University

1. ABSTRACT

Background: Infection control training sessions for recently employed nurses have an important, value especially in recent years during the outbreaks of emerging and re-emerging infections to reduce their risk to occupational infectious diseases and improve their attention to implementation of infection control policies, procedures and practices. **Aim:** The present study aimed to; assess the effect of infection control training sessions on recently employed nurses' knowledge and performance. **Method:** A quasi-experimental design was used to conduct the study in Belqas General Hospital, Dekirnis Central Hospital, Aga Central Hospital, and Nabarro Central Hospital, at Eldakahlia Governorate. The study subjects consisted of all newly employed nurses (68 nurses). Four tools used for data collection consisted of; nurses' demographic and occupational characteristics, nurses' knowledge about infection control, nurses' performance toward infection control measures, and Nurses' feedback related to training sessions. **Results**: the post-test scores of nurses' knowledge and performance after implementation of the training sessions significantly improved in the studied recently nurses 101.50 ± 12.77, 134.25 ± 18.35 compared with pre-test scores with 40.41± 12.20, 65.0 ± 15.56 (P<0.001). As determined by Cohen's d test, the effect size of an educational program is quite large on the recently employed nurses' knowledge and performance. **Conclusion**: The training sessions about infection control was significantly improved knowledge and performance of the studied recently employed nurses. **Recommendations**: Conducting ongoing education to nurses to perform in adherence to the infection control standard procedures. Also, providing orientation programs for recently employed nurses about standard precautions infection control.

Key words: *Infection Control, Knowledge, Recently Employed Nurses, Performance, Training Sessions*

2. Introduction

Infections represent a significant hazard in all health care settings. Therefore, infection control is everyone's business, and it is important that all members of the staff observe good infection control practices **(EL-Shafey, El-Dakhakhny, & Mohammed, 2019).** Health-acquired infections (HAIs), previously called nosocomial infections, are associated with admission to health care resources such as hospitals, long-term care facilities, community care facilities, ambulatory care settings, and home care **(Belal, Ahmed, Elmosaad, Abobaker, Llaguno, Mohammed Sanad, & Alkahtany, 2020).** As a result, health care-associated infection' prevention is a first priority for patient safety in all hospitals all over the world **(Wang, Liu, Tan, Harbarth, Pittet, & Zingg, 2019).**

Infection control is defined as policies, procedures, and activities, which target preventing or minimizing the risk of the spread of infections at healthcare facilities. Knowledge and practice of infection control are among the major principles that are taught in all institutions of health sciences

to the healthcare workers in training **(Abdbdullahi & Okafor, 2021)**. Infection prevention and control is a series of practices, processes, and programs within healthcare to reduce the spread of infection among patients and staff **(Popescu, 2019)**. Infection prevention and control is a central component of safe and; high-quality service delivery at the facility level. With an inadequate practice of infection prevention, the risk of acquiring infections through exposure to blood, body fluids, or contaminated materials in healthcare facilities is substantial. In connection with that, contracting an infection while in a healthcare setting challenges the basic idea that healthcare is meant to make people well. Obviously, a lack of compliance with infection prevention and control measures has a number of consequences **(Sahiledengle, Gebresilassie, Getahun, & Hiko, 2018)**.

The main reasons for low compliance are the unavailability and inaccessibility of PPE; insufficient knowledge and attitudes toward standard care (SP); less administrative

support for safe labor practices; feedback on HCW safety performance, workplace safety, work location, job category, and marital status **(Belachew, Lema, Germossa, & Adinew, 2017).** Additionally, the implementation of different intervention strategies, such as hand hygiene, personal protective equipment (PPE), disinfection and sterilization, injection safety, and proper waste disposal, adherence to standard precautions among health workers is low **(Bekele, Ashenaf, Ermias, & Arega Sadore, 2020).**

Infection control programs started focusing mainly on the Ministry of Health and Population hospitals such as university hospitals and private hospitals. Moreover, a critical component of the infection control program in Egypt is the promotion of occupational safety and health. Nurses must be aware of the problems of nosocomial infections and their effects on patients' morbidity, increased hospital stay; and costs; as well as the legal aspects concerning them **(EL-Shafey et al., 2019)**. As mentioned by **Ali, Ali,** and **Shawky (2020)** Nursing staff needs to annual continue training education in different healthcare settings. It serves as a reminder to established staff and an educational tool about the severity of infectious diseases and the means necessary to protect staff in a healthcare setting.

In healthcare settings, nurses have the most direct contact with patients. In addition, there are particular examples that nurses are implicated in the transmission of nosocomial diseases **(Mousa, & Aziz, 2022)**. Infection control training sessions for recently employed nurses have an important value, especially in recent years during the outbreaks of emerging and re-emerging infections like severe acute respiratory syndrome (SARS), Middle East respiratory syndrome coronavirus (MERS-CoV), Ebola, and COVID-19, to reduce their risk to occupational infectious diseases and improve their attention to the implementation of infection control policies, procedures, and practices **(Huh, 2020)**. Also, **Belal et al. (2020)** asserted that the nurse must have knowledge about the types of infection, the common pathogens and how they can be transmitted, the factors that predispose a patient to nosocomial infection; how to recognize those at risk, and the prevention and control measures necessary to decrease the incidence of nosocomial infection. Moreover, attendance in in-service education provides nurses with theoretical and practical evidence needed to attain certain types of skills and continuous improvement practice.

2.1 Significance of the Study

The International Classification of Diseases (ICD-10) and the Centers for Disease Control and Prevention (CDC) appraised that around 1.7 million with health acquired infections (HAIs) lead to 99,000 deaths each year and are considered one of the top ten leading causes of death **(Belal et al., 2020)**. Actually, many new nurses entered directly from nursing school, without any prior work experience. moreover, investing in the training of new nurses is crucial to patient care, it was also acknowledged to be time-consuming and rarely resulted in long-term benefits for the healthcare team **(Barker, Brown, Siraj, Ahsan, Sengupta, & Safdar, 2017)**. Regular intervention training of health care professionals especially nurses about infection control measures is required. So, this study has been conducted to improve recently employed nurses' knowledge and performance regarding infection control.

2.2 Aim of the Study

This study aims to assess the effect of infection control training sessions on recently employed nurses' knowledge and performance. The study hypothesized that the infection control training sessions will improve knowledge and performance of recently employed nurses toward infection control measures.

3. Methods

3.1 Research design

A quasi-experimental one-group pre-/posttest design study design was utilized to achieve the aim of this study **(Stratton, 2019).**

3.2 Study setting

The present study was conducted in Belqas General Hospital, Dekirnis Central Hospital, Aga Central Hospital and Nabarro Central Hospital, at Eldakahlia Governorate.

3.3 Study subject

All newly employed nurses (68 nurses) of both genders, different age categories, with different qualifications, and years of experience, who worked in the previously mentioned settings, and were willing to participate in the study were included in the current study.

3.4 Sample size

Based on a G*Power calculation of medium effect size, power set at 0.95, and α error set at 0.05, a minimum of 54 recently employed nurses is required. As per the study of **Ta'an, Al-Hammouri, Al-Faouri** and **Suliman (2022)**, an attrition rate of 25% is expected. Therefore, 68 is the minimum required sample.

3.5 **Tools of Data Collection**

Four tools were used for data collection as the following:

Tool I: Nurses' Demographic and Occupational Data

This tool included personnel and work characteristics of recently employed nurses such as: (age, sex, educational level, place of work, qualification, and experience years ……. etc.).

Tool II: Recently Employed Nurses' Knowledge About Infection Control

This questionnaire was developed by the researcher, based on recent literature reviews as **(El Sebaey, Atlam, El Kafas & Zayed, 2022; Hassan, Malk, Abdelhamed & Genedy, 2020; WHO, 2020)** to assess recently employed nurses' knowledge regarding infection control before and after implementation of the training sessions. The questionnaire was designed in English language and translated to the Arabic language to avoid misunderstanding. It is composed of 66 questions (39 multiple-choices questions, and 27 Yes and No questions). It was arranged as the following: General information about infection and infection control (9 items=25 marks), Knowledge about hand hygiene (it includes 8 items=11 marks), Knowledge about personnel protective equipment (8 items=16 marks), Knowledge about safe injection (8 items=11 marks), Information on instrument reprocessing (19 items=26 marks), Information about waste management (9 items=14 marks), Information about laundry and textiles (5 items=5 marks).

Scoring system:

The answer was evaluated using a model key answer prepared by the researcher. The "correct answer" scored one, while the "incorrect answer" scored zero. The items scores were added and divide the total score by the number of items to get the mean score for each section. These scores were converted to percentiles and means, and standard deviations were calculated. the percentages scores as cut-off points used to assess the level of knowledge. As regards nurses' responses; knowledge levels will consider good if the percent score was equal to or above 75%, average if from 50% to 75%, and poor level scores less than 50% **(Hassan, Malk, Abdelhamed, & Genedy, 2020)**.

Tool III: Recently Employed Nurses' Performance Toward Infection Control Measures

This observational checklist was developed by the researcher, based on recent literature reviews as **(Mohamed, Soliman & Abdel-Raoof, 2017; WHO, 2020)** to assess recently employed nurses' performance related to national standard precaution measures, such as (hand hygiene, donning, and doffing PPE, environmental control) before and immediate after the training sessions implementation. The checklist consisted of 64 items designed to assess nurses' practice regarding eleven main procedures rendered in daily routine nurses' work for prevention and control of infection. It was arranged under the following 11 sections: Routine hand hygiene (12 items); Hygienic hand hygiene, also called hand washing with disinfectants (12 items); Surgical hand washing (13 items); Donning sterile gloves (5 items); Doffing sterile gloves (4 items); Donning the sterile gown (3 items); Doffing the sterile gown (5 items), Donning a surgical mask (3 items), Doffing the surgical mask (3 items), How to deal with a spill of blood or other body fluids (6 items), and How to separate waste (5 items).

Scoring system

Nurses' practice was rated from 2 to 0. where 2 equals "performed correctly and completely", 1 equal "not performed perfectly but correctly" and 0 equals "not performed". The item scores were summed, and the total was divided by the number of the items and gave a mean score for the part. As regard to nurses' practices, performance levels considered good if the percent score was equal to or above 75%, average if from 50% to 75%, and poor level if scores less than 50% **(Hassan, Malk, Abdelhamed & Genedy, 2020)**.

Tool IV: Recently Employed Nurses' Feedback Related to Training Sessions

This questionnaire was adapted from **(Mohamed, Soliman, & Abdel-Raoof, 2017)** to evaluate nurses' feedback about the training sessions with respect to time, instructor, and training methods immediately after the training sessions implementation. The questionnaire consisted of the following parts: training environment (4 items), content of the training activity (6 items), and trainer skills (9 items). Nurses' answers were classified as good, average, and poor.

3.6 Validity and Reliability

Study tools were examined for content validity by five experts in community health nursing. Comments and suggestions of the experts were considered and necessary modifications, correction, and clarifying of the items were done accordingly. Before entering the actual study, the pilot study was conducted for face validity on 10% (7 nurses) of the total sample size of recently employed nurses, who were selected randomly from the above-mentioned settings. The pilot study aimed to evaluate the clarity and applicability of the research tools. In addition to, estimating the approximate time required for data collection, distinguishing the potential barriers or problems that may hinder data collection, and overcoming measures. The nurses included in the pilot study were excluded from the whole study sample. Appropriate modifications were made according to the results of the pilot study.

The reliability of tools used in this study by the Cronbach's alpha coefficient test to assess the internal consistency of the study tools. The internal consistency reliability for observational checklist practice is very high reliable emerged as (0.99). Additionally, Cronbach's α of Nurses' feedback checklist emerged as highly reliable checklist (0.78).

3.7 Fieldwork

A field study was conducted for six months from the beginning of February (2023) to the end of July (2023). The study was carried out through the following phases:

Phase I (Assessment Phase): This phase involved the preparation of data collection tools based on reviewing the pertinent current, national, and international literature. Official permissions were obtained from the manager of Belqas General Hospital, Aga Central Hospital, Nabarro Central Hospital, and Dekernis Central Hospital on recently employed nurses, to allow the researcher to carry out the training sessions. Verbal informed consent was obtained from nurses after the clarification of the study objectives and sheets of the four tools and asked them to complete them. The printed booklet containing the content of the program was designed and developed using appropriate illustrations, simple Arabic language, attractive and suitable format.

Phase II (Planning): Initial data collection for six months from four studied groups (Belkas General Hospital group, Aga Central Hospital group, Nabarro Central Hospital group, and Dekernis Central Hospital group) was done at each hospital separately. Assessment of the nurses' demographic data was measured by using tool I, and knowledge & performance related to infection control were measured by using tools I and II. Development of training sessions based on the obtained data from the initial assessment of trainers' knowledge (pre-test) by using tool II, and trainers' practice (pre-test) by using tool III was done, a suitable time for carrying out training sessions was determined, and identify teaching strategy; including teaching method (brainstorming, lecture, and group discussion), appropriate media used; including (PowerPoint slides and booklet) and evaluation method by pre-test and post-test for each part to each group. Implementation of the training sessions was done in four groups based on the following sessions (1 theoretical and 2 practical sessions). Theoretical sessions focused on: recently employed nurses' knowledge about national standard precautions for infection prevention and control; including (general information about infection and infection control, knowledge about hand hygiene, knowledge on personnel protective equipment, knowledge on safe injection, information on instrument reprocessing, information about waste management, and information about laundry and textiles. While, the two practical sessions focused on: demonstrating the appropriate sequential steps of the following procedures: routine hand washing, hand washing with disinfectants, surgical hand washing, donning sterile gloves, doffing used gloves, donning sterile gown, doffing used gown, donning a surgical mask, doffing the surgical mask, how to deal with a spill of blood or other body fluids, and how to separate waste.

Phase III (The training sessions implementation): At the beginning, the researcher met with the whole group of the studied nurse mentors in the technical health institute (branch B) and explained the aim and procedures of the study. A copy of the handout was given to each nurse mentor to facilitate remembering the knowledge and practices during the explanation of the theoretical part. The program was presented in clear and concise form using different teaching methods while discussing the rationale and precautions for each step, such as small discussions, lectures, demonstrations, and re-demonstrations and appropriate teaching media as audiovisual material and real objects. At the end of

the researcher's demonstration, nurse mentors were asked about any unclear steps that needed repetition or explanation before the re-demonstrations. The researcher emphasized that this session was done for teaching purposes not for evaluation, so mistakes and forgetting were allowed and were corrected immediately by the researcher. The study sample of recently employed nurses was divided into seven groups; each group included 8-10 nurses. The program was implemented for recently employed nurses in terms of 2 hours per session for 3 days/week for each group.

Phase IV (Evaluation phase): Evaluation of the trainers' knowledge and practice (post-test) was done by using tool II and tool III and evaluation of the trainers' feedback about the training sessions and the trainer was done by tool VI immediately after the training sessions.

3.8 Ethical Considerations

Before conducting the study, ethical approval was obtained from the research ethics committee of the faculty of Nursing, at Mansoura University. Permissions were obtained from the managers of Belqas General Hospital, Aga Central Hospital, Nabarro Central Hospital, and Dekernis Central Hospital on recently employed nurses, to allow the researcher to collect data and carry out the training sessions. The researcher informed the participant nurses that they could withdraw from the study at any time they wished to do so without any problem. The researcher has ensured the maintenance of anonymity and confidentiality of participant nurses. Moreover, the participant nurses have been assured about the discretion regarding the collected information, and that they shall be only used for study purposes.

3.9 Statistical Design

The collected data were coded and entered into the Statistical Package of Social Sciences (SPSS) version 24. After complete entry, data were explored for detect any error, then, it was analyzed by the same program for presenting frequency tables with percentages. Qualitative data was presented as number and percent. Besides, Quantitative data were described as mean ±SD as appropriate. The study data were tested for normality by the Kolmogorov-Smirnov test. For normally distributed variables, the paired sample t-test was used to indicate an actual difference between nurses' knowledge and practice mean scores before and after the application of the training sessions. Additionally, Cohen's D (effect size of t-test) was computed to evaluate the actual

effect of the educational program on the study variables. Pearson correlation (r) was performed to measure the strength of a linear relationship between total scores of nurses' knowledge and practice. It can range from -1 to 1. An r of -1 indicates a perfect negative linear relationship between variables, an r of 0 indicates no linear relationship between variables, and an r of 1 indicates a perfect positive linear relationship between variables. The Chi-Square test was used to check whether the variables are independent of each other or not. All tests were performed at a level of significance (P-value) equal or less than 0.05 was considered to be statistically significant.

4. Results

Table 1 shows that the majority (85.3%) of the studied nurses were aged 20 to less than 25 years old, with a mean age of 23.85±1.92 years old. Nearly three-fourths of them were female (73.5%). Their qualification level revealed that the nursing technical institute and baccalaureate degrees were the highest two educational levels among the studied nurses (52.9% and 45.6%, respectively). As regards nurses' dates of hiring, it was noticed that the entire sample of nurses was newly hired for a period of 2.8 ±2.2 months. Regarding their working place, nearly one-fourth of the nurses in the sample work in Belqas General Hospital (26.5%), Nabarouh Central Hospital (26.5%), Dekernis Central Hospital (26.5%), and Aga Central Hospital (26.5%).

Table 2 clarifies that the majority of the studied nurses (86.8%) had a "Poor" level of knowledge, with a mean of (40.41±12.20) score. Compared to the immediate post-test results, the level of nurses' knowledge improved to a "good" level among most of the sample (97.1%) with a mean score of (101.50±12.77). It is also revealed from the same table that the paired t-test presented a highly statistically significant difference between means of the total nurses' knowledge score toward the infection control measures throughout the two training program phases at (t=30.36, P≤0.001, d =4.89).

Table 3 elaborates the pre-test results revealed that more than two-thirds of the studied nurses (69.1%) had a "Poor" level of performance, with a mean score of (65.0 ±15.56). Compared to the immediate post-test results, the level of nurses' performance improved to a "good" level among most of the sample (94.1%) with a mean score of (134.25 ±18.35). It is also noticed from the same table that the paired t-test showed a highly statistically significant difference between means of the total nurses' performance score toward the

infection control measures throughout the two training program phases at (t=24.81, $p \leq 0.001$, d =2.09).

Table 4 elaborates the evaluation results revealed that most of the attendees (91.2%) reported a "Good" level of feedback, with a mean score of (21.00±3.14).

Table 5 reveals the strength and direction of the relationship between the total studied nurses' knowledge and observed performance level regarding the infection control measures before and immediately after the training sessions'

implementation. Concerning the correlation before the training program implementation, it was indicated from the table that there was a statistically significant moderate positive correlation between the total nurses' knowledge and observed performance level (r=0.523, $p \leq 0.001$). In relation to immediately after the program implementation, there were statistically significant strong positive correlations between the total studied nurses' knowledge and observed performance level (r=0.718, $p \leq 0.001$).

Table (1). Demographic and Occupational Characteristics of Studied Recently Employed Nurses (n=68).

Item	n (6 8)	%
Age		
20 < 25	58	85.3
≥25	10	14.7
Mean (SD)	**23.85 (1.92)**	
Gender		
Male	18	26.5
Female	50	73.5
Place of work		
Belqas General Hospital	18	26.5
Aga Central Hospital	18	26.5
Nabarouh Central Hospital	14	20.5
Dekernis Central Hospital	18	26.5
Qualifications		
Technical Institute of Nursing	36	52.9
Bachelor's degree (BSc)	31	45.6
Higher studies	1	1.5
Date of hiring (In months)		
Mean (SD)	**2.8 (2.20)**	

Table (2). Nurses' Total Score Level of Knowledge Regarding the Infection Control Measures Before, and Immediately After the Training Sessions Implementation (n=68).

Items	Pre-test n=68		Post-test n=68		Significance tests
	n	%	n	%	
Total knowledge score = (108)					
Poor	59	86.8	2	2.9	χ^2=128.26, * p ≤ 0.001
Average	9	13.2	---	---	
Good	---	---	66	97.1	
Mean (SD)	40.41(12.20)		101.50(12.77)		t=30.36, * p ≤ 0.001 d =4.89

Table (3). Nurses' total score level of observed performance regarding the infection control measures before, and immediately after the training sessions implementation (n=68).

Items	Pre-test n=68		Post-test n=68		Significance tests
	n	%	n	%	
Total practice score = (140)					
Poor	47	69.1	2	2.9	$\chi^2=$, * $p \le 0.001$
Average	19	27.9	2	2.9	
Good	2	2.9	64	94.1	
Mean (SD)	65.0(15.56)		134.25(18.35)		t=24.81, * $p \le 0.001$ d =2.09

Table (4). Nurses' Feedback Regarding the Infection Control Measures' Training Sessions Implementation (n=68).

Items	n	%
Total feedback score = (22)		
Average	6	8.8
Good	62	91.2
Mean (SD)	**21.00 (3.14)**	

Table (5): Correlation between the total nurses' knowledge and observed performance score regarding the infection control measures before, and immediately after the training sessions implementation (n=68).

Item	Total knowledge score			
	Pre-test N=68		Post-test N=68	
	r	p	r	p
Total observed practice score	0.523	≤ 0.001**	0.718	≤ 0.001**

Correlation is significant at the 0.05 level.

**Correlation is significant at the 0.01 level.*

Discussion

Infection prevention and control (IPC) is an integral part of providing nursing care in any healthcare facility to reduce the risk of morbidity and mortality for patients and healthcare providers at all levels. It is a scientific path, and a practical solution based on strengthening pathology, epidemiology, and health systems. It occupies a unique position in the global healthcare system because it is concerned with patient safety, preventing complications, and reducing additional costs to countries' healthcare system **(Kumar, Kumar, Madhu, & Sandyashree, 2022)**. Nurses play an important role in limiting the spread of organisms in two ways: first, as the health care professionals who spend the most time with patients, they have a significant opportunity to spread organisms. Before and after contact with patients, as well as after performing potentially infectious actions, nurses should perform hand hygiene. The second method that nurses use to reduce hand-to-hand transmission is to work as

health educators by teaching patients and their colleagues the basic principles of infection prevention **(Mhana, Abd El-Aziz, & Hassan, 2022; Saati, & Alkalash, 2022)**. Hence the focus of this study was to evaluate the impact of implementing infection control training sessions on recently employed nurses' knowledge and practice for preventing infection.

The target population for this study was newly hired nurses (NHN). After graduation, the nurses have to go through a difficult transition from student to professional nurse. NHN faces a number of challenges that can hinder their operations in healthcare settings and expose them and their patients to a number of problems, including nosocomial infections. Therefore, this study focused on targeting newly hired nurses to attend infection control training sessions. Newly recruited nurses were also the target of a study in Brazil by **Eichemberger, Kawagoe, Andrade,** and **Mohallem (2022)**, titled "New graduate nurses'

knowledge of specific preventive measures during the period before the COVID-19 pandemic.".

The socio-demographic and occupational characteristics of the nurses studied in the current study revealed that 73.5 % of them were female and 85.3% of them were 20 to less than 25 years old. Their qualification level revealed that the nursing technical institute and baccalaureate degrees were the highest two educational levels among the studied nurses (52.9% and 45.6%, respectively). These findings are consistent with the findings of three studies that were conducted in Iraq and Korea (**Mousa & Aziz, 2022; Talib & Ahmed, 2021; Khalid & Fawzi, 2020; Kim, Kim, & Kim, 2021**). These studies revealed compatibility in demographic and qualification data. From the researcher's point of view, the finding of the present study might be due to the fact that nurses at this age were newly graduated. As this age can provide perfect nursing intervention efficiently and correctly, so they should be aware of infection control precautions for any patient contact.

Regarding nurses' knowledge toward the general concepts of infection control, the paired t-test indicated a highly statistically significant improvement (P≤0.001) between before and immediately after mean scores with a huge effect size (d =3.6). This outcome agreed with **Ahmed, Mohamed,** and **Ahmed (2019)**, who conducted a study entitled "Effect of Educational Program about Infection Control Precautions for Nurses in Pediatric Hemodialysis Units" and cited that there is a significant difference between pre- and post-educational program regarding the knowledge about general infection control (*p*<0.001).

The infection control training sessions demonstrated a large effect size on the total nurses' knowledge score. This conclusion is supported by **Mousa** and **Aziz (2022),** who cited that "the nurses' understanding of infection control was improved following the training." It is also congruent with similar studies by **Kumar et al. (2022)** and **Saati** and **Alkalash (2022)** who concluded that "the educational program was effective in the enhancement of nursing staff knowledge about infection control measures." According to the researchers, the insufficient knowledge at the baseline assessment because of infection control is not included in the elective nursing courses for nursing students. And most of them did not attend any training sessions related to infection control. Therefore, training sessions showed a high effect size on the newly hired nurses' knowledge regarding IPC measures.

According to **Belal et al. (2020),** in-service training provides nurses with the theoretical and practical evidence required to establish certain types of skills and continuous improvement practices. In addition, **McGarity, Monahan, Acker,** and **Pollock (2023)** reported that newly graduated nurses require collaborative and comprehensive practice to build on a broad knowledge base of nursing and health sciences to continuously implement clinical skills and infection control measures based on the nursing process. Thus, the present study stressed providing in-service training for newly hired nurses regarding practices of infection control measures, including handwashing, donning and doffing of personal protective equipment, waste management, and dealing with a spill of blood or other bodily fluids.

Comprehensively, the total infection control and prevention practice score was "Poor" among 69.1% of the participant NHNs at the baseline assessment. Compared to the immediate post-test results, the level of nurses' practice improved to a "good" level among most of the sample (94.1%). The researcher explained that this poor baseline practice was due to the shortage of programs and courses in most universities and nursing institutions related to infection control precautions. This result was in the same direction as **Ashour, Khalil, Eittah, Elwan,** and **Amr (2021),** who evaluated the effect of infection control guidelines on nurses' performance and revealed that there was a highly statistically significant difference among the study staff nurses pre- and post-intervention related to the practice of all infection control precautions. Matching the results of (**Osman et al., 2021; Kumar et al., 2022; Kim et al., 2021**) who mentioned similar results regarding the practice of infection control precautions.

Secondly, the correlation between total scores of knowledge and the observed practice of the participant NHN regarding infection control precautions demonstrated a significant positive linear relationship between them before and immediately after the training sessions' implementation. This was in line with the study of **Ashour et al. (2021)**, who found a significant positive relationship between nurses' knowledge and performance level regarding infection control precautions. This finding also agreed with **Lobo, Sams** and **Fernandez (2019)**, who studied the correlation between health professionals' knowledge and practice about infection control measures and revealed a significant positive relationship between them.

Feedback is the backbone of educational interventions in clinical settings. However, it was generally misunderstood and demanding to convey effectively **(Nuuyoma, 2021)**. Obtaining feedback from the participant nurses provides guidance for changing clinical educational practices. Implementing changes based on feedback strengthens partnerships, supports learner needs, and improves their experiences. Follow-up feedback showed high levels of satisfaction with changes made based on feedback. Collecting feedback will also be a strategy continued in an ongoing effort to strengthen the teaching-practice partnership and improve the nurse educator **(Roach, Rose, & Lloyd-Penza, 2019)**. The current study obtained the participant NHN feedback regarding the delivered training sessions, which reported a "Good" level of feedback among most of the attendees (91.2%), with a mean score of 21 of the total feedback score (22).

The feedback results were in the same direction as the mixed research of **Tanabe, Hirano, Yanagisawa, Ledua,** and **Tukana (2023),** who conducted an evaluation of an education program on community orientation among community health nurses and revealed that program evaluations demonstrated high positive feedback among participants. Contrary to the study of **Abdulfatah** and **Jeehad (2020),** who reported that "overall evaluation of continuing nursing education programs is depicted as poor relative to all aspects of the program," it is also recommended to involve the staff nurses in the evaluation of the continuing nursing education programs for the reason that they are considered the consumers of such programs.

Conclusion

Based on the findings of the present study, it can be concluded that:

Following training sessions, there was a statistically significant increase in the knowledge and performance levels of recently hired nurses with regard to infection control measures. The entire knowledge of the nurses under study and their observed performance level with regard to infection control measures both before and right after the training sessions' execution showed a statistically significant correlation.

Recommendations

Based on the results of the present study, the following recommendations were suggested:

- It is important to repeat the present study under different circumstances (large sampling, other settings, measurements and duration of management) in Egypt to ensure the generalization of the findings.

- Providing orientation programs for recently employed nurses about standard precautions infection control.

- Policies and infection prevention and control procedures should be reviewed and updated to ensure strict implementation and compliance to infection prevention and control guidelines.

-Conducting periodical refresher training courses should be provided in order to keep nurses of updating knowledge and practice regarding to infection control.

References

Abdullahi, M. S., & Okafor, N. A. (2021). Socio-Demographic Variables as Correlates of Knowledge and Practice of Infection Control Among Health Care Workers in Jega Local Government, Kebbi State. *Commonwealth Journal of Academic Research, 2*(5), 80-88.

Abdulfatah, H.M., & Jeehad, S. K. (2020). Self-evaluation of Continuing Nursing Education Programs in Kirkuk Health Directorate Hospitals. *Medico Legal Update, 20*(3), 1356:1360.

Ahmed, S., Mohamed, A., & Ahmed, S. (2019). Effect of Educational Program about Infection Control Precautions for Nurses in Pediatric Hemodialysis Units. *Minia Scientific Nursing Journal, 005*(1), 77-88. doi: 10.21608/msnj.2019.187791.

Ali, E., Ali, A. E. H., & Shawky Mahamud, H. (2020). Effect of Educational program on Nurses' Knowledge and Practice Regarding Occupational Safety Strategies for Controlling Blood-Borne Infection in Pediatric Critical Care Units. *Egyptian Journal of Health Care, 11*(1), 1128-1138.

Ashour E.S., Khalil, A.K., Eittah, H.F., Elwan, W.M., & Amr, T.E. (2021). Effect of Infection Control Guidelines on Nurses' Performance among Medical-Surgical, and Obstetrics-Gynecological Departments during Coronavirus. *International Journal of*

Novel Research in Healthcare and Nursing, 8(2), 419:431.

Barker, A. K., Brown, K., Siraj, D., Ahsan, M., Sengupta, S., & Safdar, N. (2017). Barriers and facilitators to infection control at a hospital in northern India: a qualitative study. *Antimicrobial Resistance & Infection Control, 6*(1), 1-7.

Bekele, T., Ashenaf, T., Ermias, A., & Arega Sadore, A. (2020). Compliance with standard safety precautions and associated factors among health care workers in Hawassa University comprehensive, specialized hospital, Southern Ethiopia. *Plos one, 15*(10), e0239744.

Belal, S., Ahmed, S., Almessaid, Y., Abobaker, R., Blesilda, M., Llaguno, B., Sanad, H., & Alkahtany, M. (2020). In-services Education Program for Improving Nurses' Performance Regarding Infection Control Measures in a Rural Hospital. *Egyptian Journal of Health Care, 11*. 702.

Belachew, Y. B., Lema, T. B., Germossa, G. N., & Adinew, Y. M. (2017). Blood/body fluid exposure and needle stick/sharp injury among nurses working in public hospitals; Southwest Ethiopia. Frontiers in public health, 5, 299.

Eichemberger, J. & Kawagoe, J. & Andrade, L. & Mohallem, A. (2022). Newly graduated nurses' knowledge about Specific Precautions in the pre-pandemic of COVID-19. Escola Anna Nery. 26. 10.

El Sebaey, A. F., Atlam, S. A. E. M., El Kafas, E. S. A. E. R., & Zayed, H. A. (2022). Effect of infection control training course on knowledge and practices of medical interns in a large academic hospital in Egypt: an intervention study. Environmental Science and Pollution Research, 1-9.

EL-Shafey, S. A. E. B., El-Dakhakhny, A. M., & Mohammed, B. M. (2019). Effect of an educational training program for nurses about infection control precautions in their practice in the pediatric critical care. *Afro-Egyptian Journal of Infectious and Endemic Diseases, 9*(1), 20-30.

Hassan, H., Malk, R., Abdelhamed, A., & Genedy, A. (2020). Infection Control Knowledge and Practices: Program Management in Labor Units According to Standard Infection Control Precautions in Northern Upper Egypt. *American Journal of Nursing Research, 8*(4), 412-425.

Huh, S. (2020). How to train health personnel to protect themselves from SARS-CoV-2 (novel coronavirus) infection when caring for a patient or suspected case. Journal of educational evaluation for health professions, 17.

Khalid, O., & Fawzi, M. (2020). Impact of instruction booklet on Nurses Knowledge Regard Hepatitis B & c among children in Mosul City. Mosul Journal of Nursing, 8(2), 187:195.

Kim, E., Kim, S. S., & Kim, S. (2020). Effects of Infection Control Education for Nursing Students Using Standardized Patients vs. Peer Role-Play. International journal of environmental research and public health, 18(1), 107.

Kumar, G. V., Kumar, P., Madhu, M.P., Sandyashree, B. (2022). A Study to Evaluate the effectiveness of Self-Instructional Module on Knowledge and Practice regarding infection control strategies among Staff Nurses working in Labor room at selected Hospitals, Chamarajanagar. *International Journal of Advances in Nursing Management, 10*(3), 189:196.

Lobo, D., Sams, L., & Fernandez, S. (2019). Correlation between health professionals knowledge, attitude and practice about infection control measures. *Journal of Medical and Allied Sciences, 9*. 26.

McGarity, T., Monahan, L., Acker, K., & Pollock, W. (2023). Nursing Graduates' Preparedness for Practice: Substantiating the Call for Competency-Evaluated Nursing Education. Behavioral sciences (Basel, Switzerland), 13(7), 553.

Mhana, E.I.A, Abd El-Aziz, N.A., & Hassan, M.M. (2022). Nurses' performance regarding Infection Control Precautions in Primary Health Care Centers. Egyptian Journal of Health Care, 13(3), 420:431.

Mousa, A., & Aziz, A. (2022). Impact of an Intervention Program on Nurses Knowledge towards Infection Control Measures in Pediatric Surgical Wards. Mosul Journal of Nursing, 10(3), 39:45.

Nuuyoma, V. (2021). Feedback in clinical settings: Nursing students' perceptions at the district hospital in the southern part of Namibia. *Curationis, 44*(1), 1:12.

Osman, F., El Banna, H., Sharaf, A., & Mohammed, Y. (2021). The Effects of Educational Interventions on Nurses' Knowledge and Practices in Hemodialysis Unit Regarding Infection Control Practices. *The Egyptian Journal of Hospital Medicine, 84*(1), 1739:1748.

Popescu, S. (2019). Infection Prevention and Control: A Biodefense Measure. *Defense Against Biological Attacks, 1*, 145-169.

Roach, A. & Rose, A. & Lloyd-Penza, M. (2019). Using Feedback to Improve Clinical Education of Nursing Students in an Academic-Practice Partnership. *Teaching and Learning in Nursing, 14*(2), 125:127.

Saati, A. A., & Alkalash, S. H. (2022). Promotion of knowledge, attitude, and practice among medical undergraduates regarding infection control measures during COVID-19 pandemic. Frontiers in public health, 10, 932465.

Sahiledengle, B., Gebresilassie, A., Getahun, T., & Hiko, D. (2018). Infection prevention practices and associated factors among healthcare workers in governmental healthcare facilities in Addis Ababa. *Ethiopian Journal of Health sciences, 28*(2), 177-186.

Stratton, S. (2019). Quasi-Experimental Design (Pre-Test and Post-Test Studies) in Prehospital and Disaster Research. *Prehospital and Disaster Medicine, 34*(6), 573-574. doi:10.1017/S1049023X19005053.

Ta'an, W., Al-Hammouri, M., Al-Faouri, I., & Suliman, M. (2022). The effectiveness of COPA-based training program on the infection-control competencies of newly hired healthcare professionals. *Teaching and Learning in Nursing*, ISSN 1557-3087.

Tanabe, S., Hirano, K., Yanagisawa, S., Ledua, S. W., & Tukana, M. (2023). Evaluation of an Education Program on Community Orientation among Community Health Nurses in Fiji. *Nursing open, 10*(7), 4637:4646.

Talib, S.A., & Ahmed, S.A. (2021). Effectiveness of an Educational Program on Nurses Knowledge's Regarding Prevention and Precautions for Patients with Hepatitis Type (C) in AL-Suwairah General Hospital, Iraq. *Annals of the Romanian Society for Cell Biology*, 960:967.

Wang, J., Liu, F., Tan, J. B. X., Harbarth, S., Pittet, D., & Zingg, W. (2019). Implementation of infection prevention and control in acute care hospitals in Mainland China–a systematic review. *Antimicrobial Resistance & Infection Control, 8*(1), 1-16.

World Health Organization. (2020). Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected: interim guidance, 25 January 2020 (No. WHO/2019-nCoV/IPC/2020.2). World Health Organization