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REVIEW ARTICLE

EFFECT OF INFECTION CONTROL TRAINING PROGRAM ON DENTAL CLINICS NURSES' KNOWLEDGE AND PRACTICES AT RURAL HEALTH UNITS

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ABSTRACT

Background: Cross infection in dentistry has successfully gained the international concern and is taking the shape of a global problem. The Ministry of Public Health, in collaboration with the World Health Organization country office, emphasized the importance of paying greater attention to sound infection control measures during dental work practices. **Aim:** The study was conducted to examine effect of infection control training program on dental clinics nurses' knowledge and practice at rural health units. **Design:** Quasi experimental design with pre and post-test was used. **Setting:** It was conducted at 120 out of 175 dental clinics at rural health units of Ministry of health and population in six districts in Menoufia Governorate. **Sample:** Multistage random sample composed of 120 nurses, who are working in dental clinics' at rural health units of Ministry of health and population from selected six districts in Menoufia Governorate. **Tools:** Self-administered structured questionnaire included socio demographic data, knowledge of dental nurses as regard to infection control measures, and observational checklist of practice of dental nurses. **Results:** At pre infection control training program, more than three fourths of dental nurses had good level of knowledge which statistically significant increased to one hundred percent at post infection control training program. Moreover, there was 17.5% of studied nurses had a risky practice and 82.5% had safe practice compared to post infection control training program, there was statistically significant decreased in risky practice to 4.2% and improved safe practice to 95.8%. **Conclusion:** Infection control training had a profound effect on the knowledge, and practice of dental nurses about infection control measures. **Recommendation:** The need for ongoing infection control training programs for dental nurses are critical for ensuring that infection prevention measures are implicated and followed.

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INTRODUCTION

Patient safety is an important medical discipline which aims at improving quality of patient care, minimizing treatment mistakes and improving safety. Cross infection in dentistry has successfully gained the international concern and is taking the shape of a global problem. Cross infection in its simplest form can be defined as the transfer of an infectious agent from one individual to another in a clinical environment. New infectious diseases have been found at a rate of one disease per year over the past 22 years. Infectious diseases represent an important public health problem facing health care systems in many countries [Hatre, 2010]. The dental clinic is an environment where disease transmission occurs easily. Dental health care professionals are at risk of infections caused by various microorganisms such as *Mycobacterium tuberculosis*, hepatitis

B and hepatitis C viruses, staphylococci, streptococci, herpes simplex virus types 1, human immunodeficiency virus, mumps, influenza, and rubella. Nowadays we are living in an era of eco-epidemiology, with global emergence and re-emergence of many communicable diseases, emerging agents as Ebola, Middle East respiratory syndrome-corona virus, H1N1 and H5N1 and others can be also transmitted during dental practice [CDC, 2018]. Infections may be transmitted in the dental environment through several routes, including direct contact with blood, oral fluids, or other secretions; indirect contact with contaminated instruments, operatory equipment, or environmental surfaces or contact with airborne contaminants present in either droplet splatter or aerosols of oral and respiratory fluids [Gambhir, 2011]. Additionally, in Egypt HCV incidence is higher than any other country, several studies suggested dental practices are main causes, infection rates of HCV among dental nurses is 25% while risk of transmission of HBV for non-immune dental nurse is 2-40% [Mohamoud, 2013].

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Furthermore, a study conducted at the dental clinics at faculty of oral and dental medicine, Al Kasr Al Ainy Hospital, revealed that one third of dental nurses complained from percutaneous exposure incident that included complain from needle stick injury as a result of recapping of anesthesia needles after injection to patients and injury from contaminated sharp instrument when dental nurses cleaning it [Shaban, 2015]. Moreover, The Ministry of Public Health, in collaboration with the World Health Organization country office, released the results of research on the status of oral health in Egypt, it emphasized the importance of paying greater attention to sound infection control measures during dental work given the high prevalence of hepatitis C in Egypt, with some 160 000 new cases every year, about 75% of which take place in health facilities, including dental facilities [WHO, 2018].

Therefore, ongoing education and training of dental nurses are critical for ensuring that infection prevention policies and procedures are understood and followed. Education on the basic principles and practices for preventing the spread of infections should be provided to all dental health care providers, training should include both dental health care safety and patient safety [Al-Maweri, 2015]. Various studies from Sudan, Saudi Arabia, and Yemen have emphasized on the need for training programs with an implementation of an annual audit and education within the dental health care centers [Ahmed, 2014]. Infection prevention in dentistry is an important topic that has gained more interest in recent years and guidelines for the prevention of cross-transmission are common practice in many countries. Appropriate infection control practices are of prime importance in any healthcare facility to assure safety of both the patients and the dental healthcare personnel. This fact underlines the need to provide an extensive training to prevent the healthcare-related infections to the patients and to the profession. Dental nurse must have an updated understanding and knowledge on the infection control practices as part of professional ethics in providing safe clinical procedures for patients [Upendran, 2018]. Thus, this study was undertaken to examine the effect of infection control training program on dental clinics nurses' knowledge and practices at rural health units.

Significance of study: Because of their frequent direct or indirect contact with blood or blood-contaminated saliva, transmission of blood borne pathogens is of great concern to dental health care workers. It has been documented that HBV infection is the most important infectious occupational hazard in the dental profession, the risk of HBV transmission to a health care worker after the percutaneous exposure is approximately 30%, and a number of reports suggest a significantly higher incidence of HBV infection among dental staff [Laheij, 2012]. In Egypt, infection rates of HCV among dental nurses is 25% while risk of transmission of HBV for non-immune dental nurse is 2-40%, several studies suggested dental practices and poor adherence to standard infection control are main causes. Vaccination of healthcare workers for HBV has greatly reduced the risk of transmission. Moreover, patient-to-patient transmission of HBV has recently been proven. The risk of transmission of HBV through the dental practice remains an issue [El-Houfey, 2013]. Nursing science contributed to identifying specific infection prevention practices for health care workers. Having an infection control conscience helps the nurse to apply good aseptic practices at the right time and right clinical situation.

Nurse's lack of knowledge may be a barrier in prevention of infections [Brar, 2011]. Hence, this study was carried out to assess effect of infection control training program on dental clinics nurses' knowledge and practices at rural health units.

Aim of the study: The aim of the study was to examine effect of infection control training program on dental clinics nurses' knowledge and practice at rural health units.

Research hypotheses: The following research hypotheses were formulated in an attempt to achieve the aim of current study:

- J Knowledge level of dental clinic nurses about infection control measures will be improved after implementation of infection control training program (ICTP) compared to pre ICTP.
- J The mean total score of knowledge of dental clinic nurses about infection control measures will be increased at post ICTP compared to pre ICTP.
- J Level of practice of dental clinic nurses about infection control measures will be improved after implementation of ICTP compared to pre ICTP.
- J The mean total score of practice of dental clinic nurses about infection control measures will be increased at post ICTP compared to pre ICTP.

Research Questions

- J Is there relation between Knowledge and practice of dental clinic nurses about infection control measures?
- J Is there relation between knowledge of dental clinic nurses about infection control measures and demographic characteristics?
- J Is there relation between practice of dental clinic nurses about infection control measures and demographic characteristics?

Subjects and Method

Research Design: Quasi experimental design with pre and post-test was used to achieve the aim of the study

Research Setting: This study was conducted at 120 out of 175 dental clinics at rural health units of Ministry of health and population in six districts in Menoufia Governorate, setting was selected by using multistage random sample technique.

Research Sample: Multistage random sample composed of 120 nurses who are working in dental clinics' at rural health units of Ministry of health and population from selected six districts in Menoufia Governorate, according to the following stages:

- J First stage: Random selection of six districts out of ten districts in Menoufia Governorate, Egypt, the selected districts were Shebin El kom, Menouf, Tala, BerketElsab, Elbaghour and Quesna district.
- J Second stage: Random selection of 120 out of 175 dental clinics at rural health units of Ministry of Health and Population at selected six districts in Menoufia Governorate using a simple random technique from the list of dental clinics at rural health units obtained through the Directorate of Health Affairs in Shebin El kom.

-) Third stage: In each dental clinic of rural health units there was one responsible nurse and a substitute one, in which dental clinic nurse who agreed to participate in the study and attending infection control program provided written informed consent was included in the study.

Sample Size: It was calculated using the online Epi-info software for sample size calculation according to the following equation:

$$n = \frac{[DEFF * N_p(1-p)]}{[(d^2/Z_{1-\alpha/2}^2 * (N-1) + p*(1-p))].}$$

Our assumptions were:

Population size N=175 dental nurses

-) Hypothesized % frequency of Infection control knowledge among the population (p): 8% +/-5
) Confidence limits as % of 100(absolute +/- %)(d): 5%
) Design effect (for cluster surveys- $DEFF$): 1

Results from Open Epi, Version 3, open source calculator—SSPropor. Sample sizes were provided for confidence levels from 90% to 99.99%. We used 95% confidence level with approximation of sample size of 114 to 120 dental nurses as our required sample size.

Tools of the Study: Data was collected using the following tools:

Self-administered structured questionnaire: It was designed by the researchers based on review of relevant literatures to elicit the needed information [13, 14].

Personal characteristics: Included nurses' age, marital status, level of education, years of experience, and previous attending training programs related to infection control.

History about HBV vaccination status: It included questions about vaccination status against HBV, number of doses received, and post vaccination screening test,

Knowledge of dental nurses related to infection control measures: It was developed by CDC, 2016; Australian Dental Association, 2015 [13, 14] and modified by the researchers to be suitable with the Egyptian culture, included 25 items to assess knowledge of dental nurses about infection transmission during dental practice (7 items), infection control measures that should be performed routinely (10 items), sharp and non-sharp waste disposal (2 items), disinfection and sterilization measures of dental instruments as burs and hand piece (6 items). Each correct response was given two score, incorrect response and don't know was given zero. The questionnaire was evaluated giving a score of 0-50. The total score of each nurse was categorized arbitrary into "good knowledge" when the nurse achieved $\geq 75\%$ of the total score, and "poor knowledge" was considered when the nurse achieved 50 to $<75\%$ of the total score. Reliability of tool one was applied by the researcher for testing the internal consistency of the instrument, among 10 participants by using test retest method with two weeks apart between them. Then correlation coefficient (Cronbach's alpha) was calculated between the two scores. Correlation coefficient was 0.85 which indicates that tool one is reliable.

Infection control practices (observational checklist sheet): It was adopted from CDC, 2016[13], included 40 items, it was

observed by the researchers and used to assess hand hygiene practices before wearing and after removing gloves (17 items), practices of using personal protective equipment (6 items), using of aseptic technique practices (6 items), dealing with environmental surfaces (2 items), sharps and non-sharp waste management (5 items), disinfection and sterilization (3 items). Nurses' practices were studied in a list of 40 items, the responses of each item in the form of two points Likert scale (0 – 1) as one for "Safe practice", and zero for "Risky practice". The checklist was evaluated giving a score of 0-40. The total score of each nurse was categorized arbitrary into "safe practice" when the nurse achieved $\geq 75\%$ of the total score, and "risky practice" was considered when the nurse achieved from 50 to $<75\%$ of the total score. Test-retest reliability was applied by the researcher for testing the internal consistency of instrument. Its reliability has been verified with Cronbach's values of 0.79, which indicates that the tool is reliable.

Validity of the tools: The validity of the tools were done by three experts in Family and Community Nursing, Medical and Surgical Nursing and Community Medicine who examined the tools for completeness and clarity (content validity), accuracy and internal validity. Also, professors were asked to judge the relevancy, clarity, fluency, and simplicity of each component in the questionnaire and their suggestions were incorporated into the tools.

Pilot study: A pilot study was carried out on 10% of study sample to assess clarity of the tool and estimate time needed to fill each part. The necessary modification was done as revealed from pilot study. The sample of the pilot study was not included from the total sample to assure stability of result.

Ethical considerations: The researchers followed all the ethical issues in conducting the research, the participation of nurses were voluntary; confidentiality and privacy of participants were respected and allowed to withdraw from the study at any time without compensation. Also, an informed consent of participants was taken to participate in the study.

Approval: Official letter was taken from the dean of faculty of nursing in Menoufia University to the directors of Menoufia Directorate of health affairs. Permission to carry out the study from the head of dentistry, also permission was taken from infection control department in Menoufia directorate of health affairs and from directors of selected six districts to obtain their approval to facilitate data collection.

Data collection procedure:

- This study was conducted during the period starting from June 2018 and completed by the end of January 2019.
- The researchers constructed the tool after reviewing the literature that covers the various aspects of the topic by using previous studies, books and network.
- Communication with responsible authorities was needed to facilitate conduction of the study, permission to carry out the study was obtained from the head of dentistry department and infection control department in Menoufia directorate of health and affairs, they approved conducting the study, the number and names of all rural health units in each district in Menoufia Governorate were obtained.

-) •After obtaining approval and written informed consent from dental nurses to conduct the study, the researcher introduces herself and explains the purpose of study to dental clinic nurses. Then, the researchers initiated data collection from dental nurses who fulfilled the selection criteria.
- From selected dental clinics, each dental nurse who approved to participate and fulfilled selection criteria was asked to fill self-administered questionnaire including socio-demographic, personal characteristics data and knowledge about infection control measures, then infection control observational practices of dental nurses and dental clinic observational checklist sheet were filled by researcher, each data collection took about 25-30 minutes.
 - After completion of data collection (pretest), preparation of the intervention program took about one months, this intervention program was designed according to results obtained from preliminary assessment. The analysis of the data of preliminary assessment revealed low compliance of dental nurses with hand hygiene practices, mask, and protective eye wear use and changing between patients.

) •Infection control training program was constructed to assist studied nurses to raise their knowledge and try to modify their practice. It was planned with following knowledge objectives included; modes of transmission of infection and selected blood borne viral diseases (HBV, HCV), personal protective equipment, a septic technique, sharp and non-sharp disposal, methods of sterilization and disinfection of different dental instruments, the correct way of disposal of needles, skills of washing hands properly without missing any part and dealing with environmental surfaces.

 - In each of selected six health district, one work shop was carried out weekly for dental clinic nurses following each directional of each district, these amounted to six workshops, and the prepared program was conducted over a period of two months. Each workshop included 6 sessions.
 - The first session: It included importance of infection control in dentistry and diseases transmitted through dental practices. The second session: involved standard precautions and immunization. The third session: Hand washing and personal protective equipment. The fourth session included waste management. The five session: Sterilization and disinfection of patient care items, and the six session included dealing with environmental surfaces.
 - The teaching methods included lecture, discussion, summary lectures, demonstration, role play and exercises. Audio visuals materials as power point presentation and videos about infection control were used to make sessions more interesting. This method was used as it is effective tool for helping nurses to acquire information, developing self-directive learning habits and providing opportunity for active participation of nurses and enhancing the understanding of components of the program.
 - After the end of the program implementation (three months), the evaluation of the program was done through re-assessment of participants using the same data collection tools. Comparison between pre and post tests were done to find out if there is any change.

2.10. Statistical analysis: Data was coded and transformed into specially designed form to be suitable for computer entry process. Data was entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package version 22. Graphics were done using Excel program. Quantitative data as years of nurse's experience were presented by mean (X) and standard deviation (SD). Qualitative data were presented in the form of frequency distribution tables, number and percentage. It was analyzed by chi-square (χ^2) test. However, if an expected value of any cell in the table was less than 5, Fisher Exact test was used(if the table was 4 cells) , or Likelihood Ratio (LR) test (if the table was more than 4 cells). Level of significance was set as P value <0.05 for all significant tests.

RESULTS

Table (1): Shows that 45.8% of the studied subjects were 30- <40 years old, while only 23.4% of them were 20-30 years old with a mean age of 38.3 ± 0.5 years. In relation to the educational level, 68.3% of nurses have low education, and about one third (31.7%) had moderate education. Concerning the marital status, all studied nurses were married (100%).In addition; the majority of them have experience of 10-15 years. Figure 1: Illustrates that all studied nurses were attended training programs related to infection control, more than half of them (56.7%) attended the last program more than six months ago, the need for infection control training programs(ICTP) reported by nearly half of them (51%). Table (2): Illustrates that all of studied nurses had HBV vaccination, nearly three quarters (74.1%) had three doses of the vaccine, and all studied nurses had not received the post vaccination screening test for protective levels of hepatitis B surface antibody after completion of the three doses vaccination series. Table (3): Reveals that the mean total scores of knowledge subscales were statistically significant increase in post ICTP (P=0.000 for each). Also, the grand mean total knowledge score were statistically significant increased from 41.0 ± 2.1 pre ICTP to 49.3 ± 0.1 post ICTP (p=0.000).

Figure 2: Shows that at post ICTP there was a highly significant improvement (p=0.000) in the total groups of knowledge. The post program good knowledge responses were statistically significant increased from 87.5% pre ICTP to 100% post ICTP. Table (4): Reveals that the mean total scores of practice subscales were statistically significant increase in post ICTP. Also, the grand mean total practice score were statistically significant increased from 23.4 ± 3.1 pre ICTP to 33.7 ± 5.7 in post ICTP (P=0.000 for each). Figure (3): Illustrates that at post ICTP, there was statistically significant improvement in the total groups of practice (p<0.000). Additionally, safe practice observations were statistically significant improved from 82.5% % pre ICTP to 95.8 % post ICTP. Furthermore, risky practice observations decreased from 17.5% pre ICTP to 4.2%post ICTP. Table (5): Shows that, there were no statistical significant differences between the studied nurses' socio-demographic characteristics and level of knowledge about infection control measures (p>0.05 for each).46.7% of the studied sample, who had poor knowledge, were 30 – < 40 years old, (P > 0.05). Also, 66.7% of the studied sample who had poor knowledge score, were had low education (P > 0.05).In relation to experience of nurses, approximately more than three quarters (77.1%)of studied nurses who had good knowledge about infection control were had 10 –< 15 years of experience.

Table 1. Distribution of personal characteristics of the studied nurses (N=120)

Personal characteristics	No.	%
Age		
) 20-<30 years	28	23.4
) 30-<40 years	55	45.8
) 40 years	37	30.8
Mean age ± SD	38.3 ± 0.5 years	
Marital status		
) Married	120	100
Education		
) Moderate	38	31.7
) Low	82	68.3
Years of experience		
) 5-<10 years	1	0.8
) 10-<15 years	92	76.7
) 15 years	27	22.5
Total	120	100

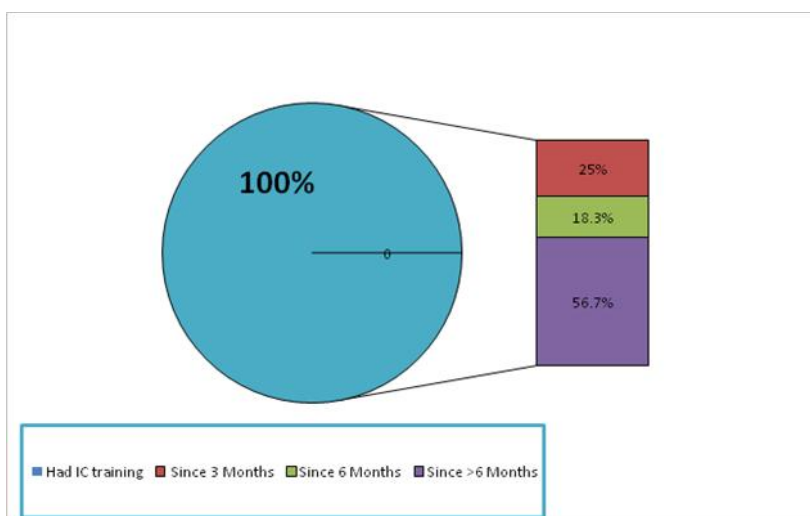


Figure 1. Distribution of studied nurses according to previous attending infection control training programs

Table 2. Distribution of hepatitis B virus (HBV) vaccination and post vaccination test among studied nurses (N=120)

HBV vaccination and post vaccination test	No.	%
Vaccination against HBV		
Yes	120	100
No	0	0.0
Number of doses received		
One	8	6.7
Two	23	19.2
Three	89	74.1
Post vaccination screening test		
Yes	0	0.0
No	120	100
Total	120	100

Table 3. Distribution of mean total scores of knowledge sub scales and grand total knowledge score among studied nurses about infection control measures at pre and post ICTP (N=120)

Knowledge subscales	Pre intervention	Post intervention	t value	P
	mean± SD	mean± SD		
Total score of infection transmission	12.7±1.2	13.5±0.7	5.6	0.001
Total score of infection control measures that should performed routinely	14.8±1.1	18.3±0.9	24.6	0.000
Total score of sharp and non-sharp disposal	4.4±0.5	5.7±0.5	17.2	0.000
Total score of disinfection and sterilization measures	7.5±0.6	10.0±0.3	43.2	0.000
Grand mean total score of knowledge	41.1±2.1	49.3±0.1	40.9	0.000

Significance (P value < 0.05)

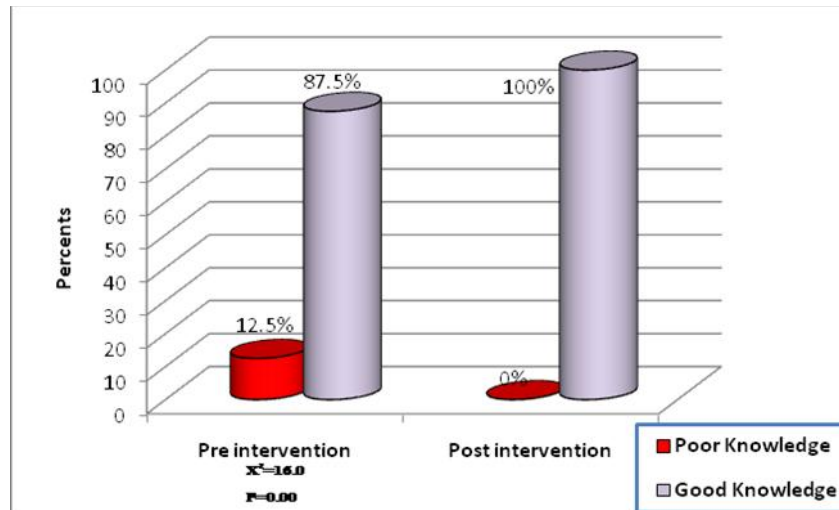


Figure 2. Distribution knowledge level of studied nurses about infection control measures at pre and post ICTP (N=120)

Table 4. Distribution of mean total scores of practice subscales and grand total practice score among studied nurses about infection control measures at pre and post ICTP (N=120)

Total score of practice subscale	Pre	Post	Paired t test	P value
	Mean± SD	Mean± SD		
Hand hygiene score	7.01±2.7	13.2±5.5	10.9	0.000
Personal protective equipment using score	3.5±0.7	5.5±1.5	13.2	0.000
Using a septic technique score	5.1±0.8	5.7±0.5	7.8	0.000
Sharp waste disposal score	7.7±1.5	9.2±0.9	9.3	0.000
Grand mean total score of observed practice	23.4±3.1	33.7±5.7	17.5	0.000

Significance (P value < 0.05)

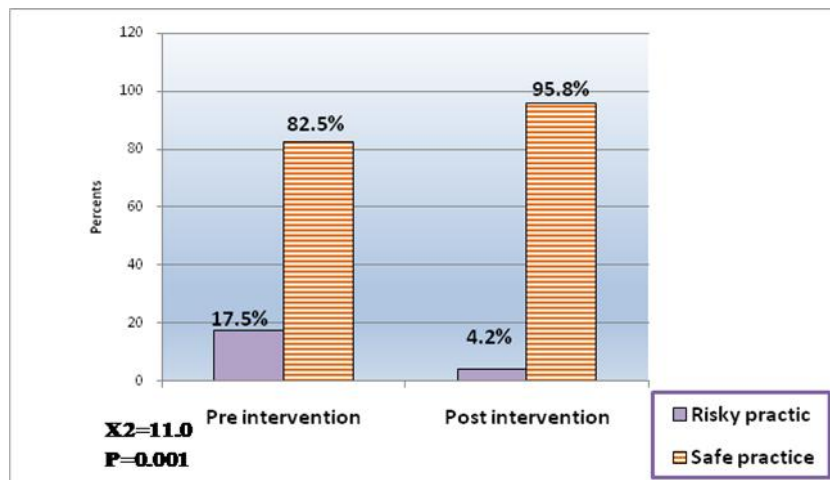


Figure 3. Distribution level of practice of studied nurses about infection control measures at pre and post ICTP (N=120)

Table 5: Relation between the nurses' socio-demographic characteristics and their level of knowledge about infection control measures during dental practice (N= 120)

Total knowledge groups		Pre intervention knowledge groups				Chi-square	
Socio-demographic characteristics		Poor		Good			
		No.	%	No.	%	X ²	P-value
Age (years)	20 - <30 years	2	13.3	26	24.8	1.2	0.54
	30 - < 40 years	7	46.7	48	45.7		
	40 years	6	40	31	29.5		
Experience	5-<10 years	0	0	1	1.0	0.30	0.86
	10- < 15 years	11	73.3	81	77.1		
	15 years	4	26.7	23	21.9		
Education	Moderate education	5	33.3	33	31.4	0.02	0.88
	Low education	10	66.7	72	68.6		
Total		15	100	105	100		

Significance (P value < 0.05)

Table 6. Relation between the nurses' socio-demographic characteristics and their level of practice about infection control measures during dental practice (N= 120)

Socio-demographic Characteristics		Total practice groups		Pre intervention practice groups					
				Risky practice		Good practice		Chi-square	
		No.	%	No.	%	No.	%	X ²	P-value
Age (years)	20 - <30 years	7	33.3	21	21.2	3.2	0.24 NS		
	30 – < 40 years	6	28.6	49	49.5				
	40 years	8	38.1	29	29.3				
Experience	5-<10 years	0	0	1	1.0	0.23	0.89 NS		
	10- <15 years	16	76.2	76	76.8				
	15 years	5	23.8	22	22.2				
Education	Moderate education	8	38.1	30	30.3	0.02	0.88 NS		
	Low education	13	61.9	69	69.7				
Total		21	100	99	100				

Significance (P value < 0.05)

Table 7. Relation between groups of total knowledge and groups of practice pre intervention (N= 120)

Groups of total knowledge	Groups of practice				Total		P value
	Risky practice		Safe practice				
	No.	%	No.	%	No.	%	
Poor	5	23.8%	10	10.1%	15	12.5 %	X ² =2.9
Good	16	76.2%	89	89.9%	105	87.5%	P=0.08 NS
Total	21	100%	99	100%	120	100%	

However, there was no statistical difference between the three groups of experience (P>0.05). Table (6): Shows that, there were no statistical significant differences between the studied nurses' socio-demographic characteristics and level of practice about infection control (p>0.05 for each). One third (33.3%) of the studied sample who had risky practice score, were 20 – <30 years old (P > 0.05). Also, 61.9 % of the studied sample who had risky practice score, were had low education (P > 0.05). In relation to experience of nurses, approximately more than three quarters (76.8%)of studied nurses who had safe practice about infection control were had 10 –< 15 years of experience. However, there was no statistical difference between the three groups of experience (P>0.05). Table (7): Shows that 23.8% of risky practice nurses were of poor knowledge, whereas only 10.1% of nurses with safe practice were of poor knowledge, and 89.9% were of good knowledge. However, the difference was not significant statistically (P=0.08).

DISCUSSION

Provision of dental care is not without risk of exposure to blood borne pathogens for both dental workers and patients. Of concern, dental nurses are at high risk for infection by blood-borne pathogens, since they are continually exposed to blood and saliva mixed with blood, and maybe even suffer needle punctures [Bekele, 2018]. Most exposures to infectious agents in the dental clinics are accidental and can be avoided by using safe work practices and following infection control guidelines. However, some exposures are not preventable; immunization and appropriate post exposure management become the key defense [Mandourh, 2017]. Therefore, the purpose of the present study was to examine the effect of infection control training program on knowledge and practices of dental nurses in rural dental clinics. Concerning attending infection control (IC) training programs, the present results showed that all studied nurses had attended IC programs; nearly two thirds of them reported the need to other courses related to IC. The present findings was consistent with Haridi *et al.*, (2016) reported high percentage of dental care workers attended training programs related to infection control. Furthermore, another study conducted by Alanazi, Alrawili, Alanazi& Shah (2018).

To assess knowledge and attitudes towards infection control of dental students, in Al-Jouf University, Saudi Arabia. They reported that majority of dental care workers had attended training programs related to infection control. However, Abu Salama, El-Shazly and Dewidar (2014) who studied infection control awareness among healthcare providers in family health care settings in Shebin El-kom district, Menoufia Governorate. They revealed that one half of nurses working in urban and rural family health settings in Shebin El-Kom district had attended IC programs, and nearly ninety percent of nurses reported a need for IC courses. The discrepancy in the percentage between the current study and other studies may be related to increasing awareness of Ministry of Health and Population about importance of infection control programs to improve knowledge and practice of health care providers or could be due to the differences in the methods and settings of the studies as well as the type of sampled health facilities. Dental health team are at a higher risk of acquiring hepatitis B viral infection as compared to the general population, also the hepatitis B virus (HBV) is more contagious and its transmission is more common than HIV in the dental clinics (Alanazi, Alrawili, Alanazi and Shah, 2018).

The current study showed that all studied nurses were vaccinated against HBV. This result was in agreement with El-Sayed and Khalifa, (2015) they conducted a study among dentists, dental nurses and cleaning staff working at Cairo Dental Research Center, Egypt concerning various aspects of infection control knowledge, attitude, and practices. They demonstrated that more than two thirds of the dental nurses received HBV vaccination. Moreover, Haridi, Al-Ammar and Al-Mansour (2016) conducted a study to assess compliance with infection control and standard precautions guidelines among dental healthcare workers in Hail Region, Saudi Arabi. They reported high percentage of dental care workers were vaccinated against HBV. Furthermore, a study conducted by Mandourh *et al.*, (2017) who evaluated awareness and implementation of infection control measures in private dental clinics in Makkah, Saudi Arabia. They found that most of dental care providers received HBV immunization. Additionally, Idris (2012) who assessed infection control knowledge and practices in public dental clinics in Khartoum

State, Sudan. He reported that more than two thirds of dental care providers had been vaccinated against hepatitis B. The result of present study showed that the percentage of nurses who received hepatitis B vaccine was higher than the result of El Houfeny, Sharkawey and Hassan (2013) who studied occupational exposure to blood and body fluids among nursing and dental students at internship year in Assiut University Hospitals and Al Azhar University Hospital, Egypt. They reported that only one third of nursing students were vaccinated against hepatitis B, so recommended hepatitis B vaccine must be given obligatory to all studied sample. This difference between the present study and other studies may be related to un awareness of importance of the vaccine in educational sector as health sector, or un availability of vaccine or fear of its complications.

In relation to post vaccination screening test, the present results showed that all studied nurse had not received post vaccination screening for protective levels of hepatitis B surface antibody after completion of the three-dose vaccination series. This finding was supported by El-Sayed and Khalifa (2015) revealed that no one of dental nurses received post vaccination screening test. This is owing to cost-effectiveness of the post-immunization test where most of dental centers only provide funding for HBV vaccination, and there is no funding or legislation which requires performing this test. Similar result was reported by Assiri et al., (2018) who carried out a study to investigate attitude and practice of infection control procedures among senior dental students of the College of Dentistry, King Khalid University, Abha. They revealed that most of dental students does not received post vaccination screening. Clinical research assessing infection control knowledge and practices among dental nurses is necessary, it provides continuous assessment for the efficacy of infection control education and training programs and assists in the development of educational interventions to improve adherence to guidelines and reduce injuries (Bekele et al., 2018). As regards to effect of infection control training program on knowledge level of studied nurses about infection control measures in dental clinic, the present result revealed that at pre infection control training program, more than three fourths of dental nurses had good level of knowledge which statistically significant increased to one hundred percent at post infection control training program. Also, the grand mean total knowledge score were statistically significant increased from 41.0 ± 2.1 pre intervention to 49.3 ± 0.1 post intervention ($p=0.000$). This result was consistent with Abdel-Rasoul et al., (2017) they conducted a study to assess effect of an educational health program on knowledge, attitudes and practices of healthcare workers with respect to nosocomial infections in the National Liver Institute, Egypt. They revealed that the majority of nurses had good level of knowledge about infection control measure at pre intervention with statistically significant increased at post infection control training program. Also, the mean total score was 95.8 ± 7.5 which increased to 97.7 ± 6.4 . Moreover, Ladia and Gupta (2017)[24] who evaluated effectiveness of training program related to infection control and waste management in a private dental college, Pune, reported that nearly half of dental students had good knowledge at baseline, which improved to eighty percent after the training and the mean knowledge score was increased after the training with statistically significant difference between pre and post training. Moreover, a study by Basarkar (2014)[25] among hospital staff in Maharashtra observed that there was a highly significant improvement in knowledge scores after educational

intervention; the mean pre-training knowledge score was 9.3 ± 3.9 , which improved to 20.0 ± 2.4 . On the same line, Abdullah, Jarallaha, and Ahmed (2016) carried out an intervention study among nurses working at a military hospital in Saudi Arabi. They revealed that the total knowledge score was significantly increased in post intervention to more than ninety percent and the total mean scores of knowledge of standard precautions as a whole were statistically significant increased from 31.86 to 68.61 in the post intervention. Additionally, Nour-Eldein and Mohamed (2016) conducted study to assess effect of education intervention on prevention of blood borne infections for health care workers in family medicine centers, Suez Canal University, Ismailia City, Egypt. They showed that the total knowledge score was statistically significant increased to one hundred percent at post intervention and grand mean of knowledge increased from 40 ± 13.3 to 75.1 ± 14 . As regards to the mean total scores of knowledge subscales about infection control measures that included infection transmission, infection control measures that should performed routinely, sharp and non-sharp disposal, and disinfection and sterilization measures. The present findings showed that there were statistically significant increase in all subscales in post infection control training program ($P=0.000$ for each). This result was supported by Mahfouz et al., (2008)[28] conducted study for assessment of needle stick injuries and related knowledge among health care workers participating in an infection control-training program at El Minia University Hospital. They showed that the knowledge of dentists regarding correct disposal of sharps after usage was significantly changed to 100% post intervention ($P=0.000$), while knowledge regarding correct sterilization of medical equipment changed significantly by 18.7% after intervention ($P=0.04$). In addition, management of needle stick injury knowledge was significantly improved by 63.3% post-intervention. Additionally, Nour-Eldein and Mohamed (2016) conducted study to assess effect of education intervention on prevention of blood borne infections for health care workers in family medicine centers, Suez Canal University, Ismailia City, Egypt, revealed statistically significant increased at all areas of knowledge at post intervention as knowledge of health care workers about infection transmission, infection control measures performed routinely and sharp disposal.

Concerning effect of infection control training program on practice of studied nurses about infection control measures, the present result showed that at pre infection control training program, there was 17.5% of studied nurses had a risky practice and 82.5% had safe practice compared to post infection control training program, there was statistically significant decrease in risky practice to 4.2% and improved safe practice to 95.8%. Also, the total mean score of practice was statistically significant increased from 23.4 ± 3.1 pre ICTP to 33.7 ± 5.7 post ICTP. The present result concurs with Ladia & Gupta (2017)[24] demonstrated that the post program good practice observations increased from eighty percent up to one hundred percent, and the mean total practice score increased from 23.4 pre intervention up to 33.7 post intervention, this increasing was statistically significant. Additionally, Basarkar (2014) who observed that there was a highly significant improvement in practice scores after educational intervention, the mean pre-training practice score was 7.8 ± 3.8 , which statistically significant improved to 21.6 ± 3.8 . Moreover, Farotimi, Ajao, and Nwozichi (2018) who conducted a study to evaluate effectiveness of training program on practice of infection control measures among nurses in two teaching

hospitals in Ogun State, Nigeria. They reported that infection control training was effective in improving practice of infection control intervention group than control group with statistical significant difference between intervention and control group.

As regards to practice subscales for studied nurses in dental clinics which included and hygiene, personal protective equipment using, using a septic technique and sharp waste disposal, the present study showed that there were statistically significant increase in all practice subscales at post intervention. This result was supported by Nour-Eldein and Mohamed(2016)[27]revealed statistically significant increase in all areas of practice and all practice subscales for health care workers in family medicine centers, Suez Canal University, Ismailia City at post intervention, and the grand mean of practice increased from 35.6 ± 11.3 to 62.4 ± 12.3 at post intervention. .

Regarding relation between levels of knowledge and socio-demographic characteristics of studied nurses, the present study revealed no statistical significant differences between the studied nurses' socio-demographic characteristics which included age, education and experience and the levels of knowledge about infection control. This result supported by Alrubaiee et al., (2018) revealed no significant association between previous working experience of Yemeni Nurses and the level of nurses' knowledge of infection control measures ($P=0.68$). Concerning the relation between levels of practice and socio-demographic characteristics of studied nurses , the present result showed that there was no statistical significant differences between the studied nurses' socio-demographic characteristics and the level of practice about infection control measures, this result concurs with Alrubaiee et al., (2018)[30] revealed that there was no significant association between the level of Yemeni nurses' practices of infection control measures and their socio demographic characteristics ($P=0.92$). Also,Dagher et al., (2017)[31]reported that the level of compliance doesn't affected by socio-demographic characteristics of lebanon dentists. In contrast, Bommireddy, et al., (2016)[32]conducted a study to obtain information about procedures used for prevention of cross-infection in dental practices in Guntur district, India which revealed a statistical difference between level of practice and level of education. Concerning relationship between nurse's levels of knowledge and practice, the present study showed that there was no statistical significant differences between the levels of knowledge and levels of practice of nurses about infection control measures , this result was supported by Mehta et al., (2017)[33] they reported that no correlation was found between levels of knowledge and practice. They suggested that in spite of the knowledge and positive attitude towards infection control protocol, the same is not put to practice.

Conclusion

Based on the results of this study, it was concluded that, there was statistically significant improvement in the level of knowledge of nurses' about infection control measures which significant increased to one hundred percent at post infection control training program compared to more than three fourths at pre infection control training program. Additionally, there was statistically significant decrease in a risky practice to 4.2% and improved safe practice to 95.8% at post infection control training program.

Recommendation

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

- J) The need for ongoing infection control training programs for dental nurses are critical for ensuring that infection prevention measures are implicated and followed.
- J) Establish an Infection Control Committee that will be responsible for planning, monitoring, control, and evaluation of infection control measures in all clinics
- J) The need to raise the awareness of health care workers about the importance of hepatitis B vaccination and post screening.

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