

## Efficacy of COVID-19 Prevention Educational Program on Nurses' knowledge and Practices at Hemodialysis Unit

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### Abstract

**Background:** COVID -19 infection, the current pandemic, is a global emergency in more than 150 countries. Health care professionals are struggling to prevent the transmission of this highly contagious disease. Although there are numerous publications relating to dialysis and COVID-19, many are in the form of preliminary reports. **Aim:** The current study aimed to assess the efficacy of the COVID-19 prevention educational program on nurses' knowledge and practices at hemodialysis unit. **Method:** A quasi-experimental pre/post-intervention design was used with a convenience sample of 30 nurses working in the Hemodialysis Unit at Mansoura University Hospital. The data were collected by using three tools: COVID\_19 infection structured questionnaire, nurses' practices observational checklist, and COVID-19 infection control perceived barriers. **Results:** Statistically significant differences were noted in the total mean scores of nurses' knowledge and practices regarding the prevention of COVID-19 infection before and after the educational program. Overcrowded at a hemodialysis unit and insufficient supplies for implementation of infection control practices have been mentioned as perceived barriers by the majority (93.3%) of our participant nurses. **Conclusion and Recommendations:** Educational program had a positive effect in improving nurses' knowledge and practices toward the prevention of COVID-19 infection, and this will be positively reflected on patients' outcomes. Hence, it is recommended to provide the nurses more organizing continuous educational programs with continuous follow-up to keep them competent and up-to-date.

**Keywords:** COVID-19 Infection, Educational program, Nurses Knowledge, practices

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### Introduction

COVID 19, the disease caused by a coronavirus, leads to a global pandemic. In the middle of December 2020, about 71,351,965 confirmed cases worldwide and 1,612,372 deaths (WHO Coronavirus (COVID-19) Dashboard, 2020). This disease causes not only damage to the lungs but also can affect other organs in the body including the kidneys and heart even the patient had no underlying problems before infected with coronavirus (Jain, 2020).

Sperati, (2020) reported that the impact of COVID 19 on kidneys isn't clear yet but some possibilities may explore this effect. First of all new coronavirus can invade kidney cells because kidneys have receptors that enable this virus to attach, invade it and make copies of itself. These receptors are similar to those present in the lungs and heart where the new coronavirus is shown to cause injury.

Another possibility is that patients, suffering from pneumonia as a result of coronavirus, will have low oxygen levels (hypoxia) (Brouqui et al. 2021).

**According to Palm and Koeners (2018)**, hypoxia can cause kidney problems. Also, **Safa and Sise (2020)** reported that blood clots that are found in kidney biopsies from COVID-19 patients can affect proper kidney functioning.

Another mechanism of COVID-19 induced kidney injury is the occurrence of a cytokine storm (Sudden large influx of cytokines) which can cause severe inflammation. This inflammatory reaction can destroy kidney cells (**Ahmadian et al. 2020**)

Patients on hemodialysis face challenges because they have comprised immunity and a high burden of comorbidities (**Akbarialiabad et al. 2020**). According to a study conducted by **Creput, Fumeron, Toledano, Diaconita, & Izzedine (2020)**, COVID-19 has a poor prognosis in patients undergoing maintenance hemodialysis. In their study, 19 % of 200 maintenance hemodialysis patients had been diagnosed with COVID-19, with 21% of these patients dying.

Governments and health care systems including nurses all over the world are rapidly responding to the COVID-19 pandemic (**Paterson et al. (2020)**). According to the world health organization, there are about 43.5 million health care workers all over the world; half of them are nurses so they are the front lines of this pandemic (**WHO, 2021**). About 29% of health care workers in a study done in China were infected with COVID-19. Also, on 29 April 2020 turkey's ministry of health reported 7428 COVID-19 infections between health care workers (**Semerci, Kudubes, and Eşref, 2021**). According to a study done in Egypt by **Kassem et al. 2020** prevalence of COVID-19 among gastroenterology health care workers is 13.5%.

From our clinical observation in the hemodialysis mentioned setting, no recorded data were found concerning the educational program for nurses dealing with hemodialysis patients. It is important to enhance their knowledge and practice to decrease the risk of exposure to COVID-19 infection between them and between patients. Centers for disease control and prevention (CDC) set guidelines for COVID-19 prevention and control between patients on maintenance hemodialysis which includes the following screen and triage patients before entering to hemodialysis unit, ensure that patients wear masks and sanitize their hands, separate patients at least 6 feet, ensure that health team wears appropriate personnel protective barriers (PPE) while providing care for patients, maintain adequate hand hygiene, environmental cleaning and visitors access, and manage patients with confirmed COVID-19. Besides give health education for patients to protect themselves from COVID-19 (**Meijers, Messa, Ronco, 2020**).

### **Aim of the study**

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This study aimed to assess the efficacy of COVID-19 prevention educational program on nurses' knowledge and practices at hemodialysis unit.

### **Research hypothesis**

An educational program will improve nurses' knowledge and practices toward the prevention of COVID\_19 infection at hemodialysis unit.

### **Subjects and method**

#### **Research design:-**

A quasi-experimental design “pre and post-test” was conducted. It is mainly

used to estimate the efficacy of an intervention on certain outcomes without randomization (Polit & Beck, 2018).

#### **Setting:-**

This study was conducted in the Hemodialysis Unit at Mansoura University Hospital, this unit has 23 beds which receive about 95 patients per week “chronic renal failure patients” and offer 250-300 freely monthly hemodialysis sessions.

#### **Subjects: -**

The study involved a convenience sample of 30 nurses regardless of their age and years of experience accepted to take part in this investigation, working in the above-mentioned setting and providing care for patients undergoing hemodialysis.

#### **Tools of data collection:**

Data were collected using the following three tools

#### **Tool I: COVID\_19 Infection Structured Questionnaire:**

It aimed to assess nurse's knowledge about the prevention of COVID\_19 infection at hemodialysis unit in the form of multiple-choice and true or false questions. It was developed and written in the Arabic language by the researchers based on reviewing the related literature (Interim Additional Guidance for Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed COVID-19 in Outpatient Hemodialysis Facilities, (2020); Shu-Ching, Yeur-Hur & Shiow-Luan (2020); International Society of Nephrology Recommendations (2020). It comprises of two parts:

**Part one:** It was concerned with the demographic characteristics of the participants which included nurse's age, gender, education level, years of experience, previous training regarding COVID-19.

**Part two:** It was concerned with nurses' knowledge about COVID\_19 infection prevention at hemodialysis unit, which was divided into two main categories:

- First: Knowledge about COVID\_19 which includes definition, causative organism, manifestations, modes of transmission, required investigations, and course of treatment (17 Items)

- Second: Knowledge about followed practices to prevent COVID\_19 infection at hemodialysis unit which includes protective ways against COVID\_19, the use of personal protective equipment (PPE), ways of maintaining sterilization at hemodialysis unit (19 Items).

#### **The scoring system**

Each item scored as (1 point) for the correct answer, (0 point) for incorrect answer. The rating scale of all questions was collected. The total score was 36 grades. The total score represented 100%. A score of less than 80% was considered an unsatisfactory level of knowledge while a score of more than or equal 80% was considered a satisfactory level of knowledge.

#### **Tool II: Nurses' Practices Observational Checklist:**

It was developed by the researchers based upon relevant literature (international society of nephrology, 2020; *Coronavirus Disease 2019 (COVID-19) Outpatient Dialysis Facility Preparedness*

*Assessment Tool*, 2020; Verma, Patel, Tio & Waikar, 2020; Suri et al., 2020, and Akbarialiabad et al., 2020). It aimed to assess the nurse's practices provided to prevent COVID\_19 infection at hemodialysis unit. It was divided into three main categories:

- **First:** Nursing practices before hemodialysis to prevent COVID\_19 infection which includes checking patient's body temperature, PPE, separate patients at least 6 feet in waiting areas, provide facemask for all patients, and assure the availability of alcohol-based hand sanitizer, tissues, and no-touch receptacles at the hemodialysis unit. (8 Items).

- **Second:** Nursing practices during hemodialysis to prevent COVID\_19 infection which includes separate patients in the treatment areas by at least 6 feet, isolate hemodialysis suspected patients with COVID\_19, ask patients to wear facemask at all times, restrict visitors, position supplies close to dialysis chair and nursing station. (6 Items).

- **Third:** Nursing practices after hemodialysis to prevent COVID\_19 infection which includes disconnect and discard blood tubing and dialyzer and also all single-use supplies, cleaning and disinfecting of all reusable equipment, check of presence of blood on the surface, wear clean gloves, apply disinfectant to all surfaces, follow standard procedures for discarding of used items, keep contaminated items away from cleaned one, remove gloves and wash hands. (13 Items)

#### **The scoring system:-**

Each done practice was given 1 point and zero point was given for not done practice. A total score was 27

(represented 100%). Scores  $\geq 80\%$  were considered a satisfactory level of practice while scores  $< 80\%$  were considered an unsatisfactory level of practice.

#### **III: COVID-19 infection control perceived barriers:**

It was developed by the researchers based on the related literature (Saqlain et al., 2020; Salas et al., 2020). Seven items have been selected concerned with the limitations that interfere with the implementation of COVID\_19 infection control policies. It included overcrowded at hemodialysis unit, unavailability of required supplies and equipment for COVID-19 infection control, non-compliance with infection control policies, not trained on infection control policies, knowledge deficit about methods of transmission of COVID\_19. For each barrier, responses were coded as yes or no.

#### **Validity and Reliability:**

Content validity was tested by a jury of 5 experts in the fields of Medical-Surgical Nursing, Critical Care and Emergency Nursing. The experts revised the tools for clarity, relevancy, comprehensiveness, simplicity, and applicability; minor modifications were done and the final form was developed. To ensure the validity of tool I translation, the back-translation technique was used.

Testing reliability of the proposed tools was estimated using Chronbach's Alpha test to measure the internal consistency of the tools. It was found that Chronbach's Alpha test for tool I was 0.974, 0.949 for Tool II, and 0.922 for tool III which reflects reliable tools.

### Pilot Study

A pilot study was carried out on 10% of the participant nurses before data collection to test the applicability and feasibility of the tools and to make necessary modifications before conducting the main study. Nurses who were included in the pilot study were excluded from the study sample.

### Ethical Considerations

Ethical approval was granted from the responsible authorities of the faculty of nursing at Beni-Suef University after an explanation of the purpose of the study. Official permission was obtained from Mansoura University Hospital administrative authority providing the details about the nature of the study. Informed consent was obtained from the eligible nurses before starting the data collection procedure to explain the purpose of the study. Nurses were assured that their participation is voluntary and they had the right to withdraw from the study at any time without penalty. They were assured that anonymity and confidentiality of information were protected. Ethics, values, culture, and beliefs were respected.

### Data collection

Data were collected started from the first of November 2020 to the end of January 2021. It was collected throughout three phases as follow:

#### Phase I: Pre-implementation phase (Initial assessment):

The researchers collected data before conducting the COVID\_19 infection control educational program to have baseline data related to nurses' knowledge and practice regarding

prevention of COVID\_19 infection at hemodialysis unit through:

- **Nurse's Observational Checklist:** It was filled by the researchers using Tool II. Each nurse was observed for conducting infection control policies and practices for the prevention of COVID-19 throughout the hemodialysis procedure from its initiation till its termination at the morning and afternoon shift.

- **Structured Questionnaire Sheet (pre-test)** for assessing nurses' knowledge. After completing the observation for all nurses, the questionnaire sheet (pretest) was distributed to all nurses and they were asked to fill it. Nurses required about 15 minutes to complete the questionnaire. Data were collected for four weeks.

- **Perceived barriers tool:** It was filled by the participant nurses at the time of completing the questionnaire sheet only once with the pre-test sheet.

#### Phase II: Implementation phase:

During this phase, nurses were divided into small groups (5 nurses/session) each group perceived the same educational program content using the same teaching strategies and handout. The total number of groups was 6 groups and the total time for achieving the teaching guideline was 2 hours for each group. Explanation of the designed COVID\_19 infection control program using PowerPoint presentation, discussion, demonstration, and re-demonstration was also conducted during each session. The total number of sessions was two sessions for each group, the theoretical and the practical session.

**The theoretical session** (1 hour including discussion) was carried out to

provide knowledge about; the program objectives (general and specific), COVID\_19 definition, causative organism, manifestations, modes of transmission and required investigations, protective measure to control the spread of COVID\_19 infection among hemodialysis patients, appropriate dealing with suspected hemodialysis patients with COVID\_19, protective measures for health care workers against COVID\_19 infection at hemodialysis unit, special policies for the prevention of COVID-19 infection at hemodialysis unit, correct method of handwashing and the appropriate use of personnel protective equipment.

**The practical session** (1 hour including discussion) was carried out to cover COVID\_19 infection control practices before, during, and after hemodialysis. a demonstration and re-demonstration of the procedures were used.

During each session, The terms used by the researchers were plain, brief, and simple. The researchers included an overview at the end of each session to highlight the most relevant points discussed. Nurses were asked questions related to the topics addressed in the previous session before the start of each session to ensure that they understood the instructions and to strengthen their knowledge. The researchers re-emphasized any points that were missed or vague.

**A designed educational booklet** regarding the COVID\_19 infection control program at the hemodialysis unit was given to the participant nurses. It was written in a simple arabic language with various colored illustrations to grasp their attention and reviewing the knowledge at home.

### **Phase III: Evaluation phase (Post-educational program):**

Nurses' knowledge and practices were evaluated after the implementation of the educational program. The knowledge was evaluated using the tool I and the practices of nurses were evaluated using tool II. A Comparison between nurses' knowledge and practice scores were done pre and post the educational program.

### **Statistical Analysis:-**

Data were fed to the computer and analyzed using IBM SPSS software package version 25.0 (Armonk, NY: IBM Corp). Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution Quantitative data were described using range (minimum and maximum), mean, standard deviation. The significance of the obtained results was judged at the 5% level. McNemar and Marginal Homogeneity test was used to analyze the significance between the different stages. Pearson Correlation Coefficient and Paired t-test was used for normally distributed quantitative variables, and to compare between two periods. The ANOVA test was utilized to differentiate between repeated measures.

### **Results**

**Table 1** illustrated that more than half of the nurses (53 %) were male. Half of the studied nurses (50%) were less than 25 years and 3.3% were more than 45 years old. Concerning marital status, more than half of the studied nurses (53.3%) were married. Regarding the educational level of nurses, half of them (50%) were technical institute while 40% of them had Bachelor's degree. The results also showed that 50% of nurses

had 2<5 years of experience and more than two-thirds of them (70%) reported that they didn't attend any training programs concerning COVID\_19 infection control.

**Table 2** showed highly statistically significant differences ( $P < 0.001$ ) between the total nurses' knowledge mean score and the total nurses' practices mean score pre and post the educational program ( $68.15 \pm 25.09$  &  $70.25 \pm 5.79$ )

**From table 3** it was found that male nurses had statistically significant difference with female regarding pre and post-program knowledge with  $t(p) = 2.154^*$  (0.043\*),  $3.184^*$  (0.005\*) respectively while for practices, male nurses had a statistically significant difference with a female during post-program only with  $t(p) = 2.408^*$  (0.023\*). There was no statistically significant difference between nurses' knowledge or practices and age & education. Regarding years of experience, there was a

statistically significant difference between nurses' practices and those who work less than 2 years  $F(p) = 4.254^*$  (0.014\*). Also, nurses who attend courses had a statistically significant difference with knowledge at pre-program  $t(p) = 2.054^*$  (0.049\*).

**Table 4** revealed that there was a negative correlation between the score of nurses' knowledge and practices pre the educational program  $r = (-0.595)$  while there was a weak positive correlation between nurses' knowledge and practices post the educational program  $r = (0.276)$  that not reach a significant level.

**Figure 1** showed that the overcrowded at a hemodialysis unit and insufficient supplies for implementation of infection control practices have been mentioned as perceived barriers for implementation of infection control practices for prevention of COVID-19 at hemodialysis unit by the majority (93.3%) of our participant nurses.

**Table (1): Distribution of the studied nurses according to their demographic data (n = 30)**

Demographic data	No.	%
<b>Gender</b>		
Male	16	53.3
Female	14	46.7
<b>Age</b>		
18<25	15	50.0
25<35	12	40.0
35<45	2	6.7
45 or more	1	3.3
<b>Marital status</b>		
Single	14	46.7
Married	16	53.3
<b>Education</b>		
Diploma	2	6.7
Technical institute	15	50.0
Bachelor	12	40.0
Others	1	3.3
<b>Experience</b>		
<2years	6	20.0
2<5years	15	50.0
5<10years	6	20.0
10 or more	3	10.0
<b>Attend courses</b>		
Yes	9	30.0
No	21	70.0

**Table (2): Total Nurses' Knowledge and Practices Mean Score Pre and Post the Program (n=30)**

	Pre	Post	t	p
<b>Knowledge Mean Score</b>				
Min. – Max.	16.67 – 91.67	72.22 – 100.0	5.621*	<0.001*
Mean ± SD.	68.15 ± 25.09	94.07 ± 7.50		
<b>Practices Mean Score</b>				
Min. – Max.	14.81 – 77.78	66.67 – 96.30	11.924*	<0.001*
Mean ± SD.	37.28 ± 13.40	70.25 ± 5.79		

t: Paired t-test

p: p-value for an association between pre and post-program

\*: Statistically significant  $p \leq 0.05$



**Table 3: Relation Between Nurses' Total Knowledge and Practices Mean Score and their Demographic Data (n = 30)**

Demographic data	Knowledge		Practices	
	Pre Mean ± SD.	Post Mean ± SD.	Pre Mean ± SD.	Post Mean ± SD.
<b>Gender</b>				
Male	77.08 ± 17.73	97.74 ± 4.08	32.87 ± 9.06	72.45 ± 7.15
Female	57.94 ± 28.82	89.88 ± 8.41	42.33 ± 15.96	67.72 ± 1.74
<b>t(p)</b>	2.154* (0.043*)	3.184* (0.005*)	1.958 (0.064)	2.408* (0.023*)
<b>Age</b>				
<25	70.93 ± 22.95	97.04 ± 5.40	33.58 ± 10.52	70.37 ± 3.43
25<35	67.13 ± 26.64	89.81 ± 8.40	42.28 ± 15.83	70.99 ± 8.33
35<45	55.56 ± 51.07	94.44 ± 7.86	38.89 ± 18.33	66.67 ± 0.0
45 or more	63.89	100.0	29.63	66.67
<b>F(p)</b>	0.226 (0.878)	2.674 (0.068)	1.063 (0.382)	0.423 (0.738)
<b>Education</b>				
Diploma	41.67 ± 31.43	94.44 ± 7.86	40.74 ± 15.71	66.67 ± 0.0
Technical institute	61.85 ± 28.41	95.19 ± 4.98	39.01 ± 15.33	68.89 ± 2.73
Bachelor	79.40 ± 14.43	93.06 ± 10.29	34.57 ± 11.75	72.84 ± 8.10
Others	80.56	88.89	37.04	66.67
<b>F(p)</b>	2.181 (0.114)	0.320 (0.811)	0.270 (0.847)	1.539 (0.228)
<b>Experience</b>				
<2years	82.87 ± 5.39	98.15 ± 4.54	32.72 ± 4.33	76.54 ± 10.12
2<5years	68.70 ± 26.51	93.33 ± 8.96	33.83 ± 12.43	69.38 ± 2.96
5<10years	63.89 ± 28.76	92.13 ± 6.44	42.59 ± 10.67	67.90 ± 1.91
10 or more	44.44 ± 22.74	93.52 ± 5.78	53.09 ± 24.10	66.67 ± 0.0
<b>F(p)</b>	1.773 (0.177)	0.759 (0.527)	2.657 (0.069)	4.254* (0.014*)
<b>Attend courses</b>				
Yes	79.01 ± 13.69	91.67 ± 10.94	34.57 ± 10.64	73.25 ± 9.22
No	63.49 ± 27.60	95.11 ± 5.48	38.45 ± 14.51	68.96 ± 2.98
<b>t(p)</b>	2.054* (0.049*)	0.896 (0.392)	0.720 (0.477)	1.947 (0.062)

t: Student t-test

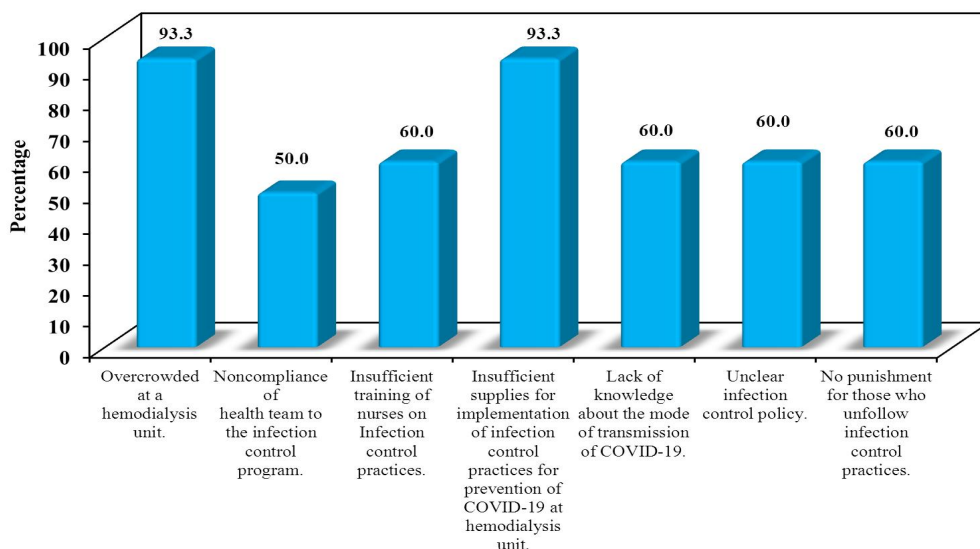
F: ANOVA test

\*: Statistically significant at  $p \leq 0.05$ **Table 4: Correlation between nurses' knowledge and practices pre and post the program period (n = 30)**

	r	Knowledge	
		Pre	Post
Practices		-0.595*	0.276
	p	<0.001*	0.139

r: Pearson coefficient

\*: Statistically significant at  $p \leq 0.05$



**Figure (1) perceived barriers for implementation of infection control practices for prevention of COVID-19 at hemodialysis unit**

## Discussion

Patients on hemodialysis are at increased risk for COVID-19 infection as they are going to hospitals two or three times per week and they have compromised immunity. So there is a desperate need of enhancing nurses' knowledge and practices to combat the evolution of COVID-19 outbreak among hemodialysis patients. This is the same line with **Tamang et al. (2020)**; **Al-Dossary et al. (2020)** who reported that providing an educational program for nurses could improve awareness and preparedness for tackling COVID-19. Hence, this study aimed to enhance nurses' knowledge and practices regarding the prevention of COVID-19 infection at hemodialysis unit.

The findings of this study revealed that more than half of the studied nurses were males. This could be due to the increasing number of males who select nursing as a career nowadays in Egypt. This finding is consistent with **Alrubaiee,**

**Al-Qalah, and Al-Aawar (2020)** but contradicted with a study done by **Mohammed et al. (2020)** who revealed that most of the studied nurses were female.

Regarding attending courses, only one-third of them attended courses for COVID-19 infection control which contradicted with **Semerci, Kudubes, & Eşref (2021)** in which near half of nurses attended courses for prevention of COVID-19. This finding may be attributed to the lack of in-service education and training for nurses in the study settings. Inadequate nurses' training could be due to organizational factors such as unavailable training funds and shortage in nursing staff which hinders their attendance of training programs outside the hospital.

During the pre-program period, the findings of the current study illustrated that the mean of nurses' knowledge was unsatisfactory as this pandemic requires high qualifications to be able to win in

this battle. This may be due to a lack of training courses attendance for infection control. This finding is harmonious with the study done by **Nashwan et al., (2021)** who found that 53% of nurses had a competent level of knowledge which forced the researcher to recommend the ministry of health to improve nurses' level of knowledge.

Post the implementation of the educational program period, a significant improvement in nurses' knowledge regarding the prevention of COVID-19 infection was noted. This was expected as education changes knowledge, skills, and attitude. This is supported by another recent study done by **Shu-Ching, Yeur-Hur & Shiow-Luan (2020)** who confirmed the importance of applying the latest knowledge of COVID-19 to protect nursing staff and all health care professionals.

For nurses' practices during the pre-program period, the mean score of nurses' practices was an unsatisfactory level which enforced the researchers to determine the causes through utilizing a sheet containing barriers for implementation of infection control measures, the results found that the overcrowded at hemodialysis unit, insufficient supplies, noncompliance to infection control program and insufficient infection control practices training were the most common causes. This is in the same line with a study done by **Bekele, Tolossa, Tsegaye & Teshome (2021)** who revealed that insufficient supplies and decreased trained health personnel were a global problem in combating this disease.

A significant improvement in nurses' practices was noted post the educational program. This improvement could be attributed to the content and process of the educational sessions, which

met the individualized needs of the studied nurses. In addition to the trials of the researchers to overcome the barriers of implementation of infection control practices. This finding was supported by the results of **Buheji and Buhaid, (2020); Choi et al. (2020)** who confirmed the strong need for the availability of resources to ensure effective nursing education

Regarding the relation between nurses' demographic data and both knowledge and practices, there was a statistically significant difference between males and females regarding knowledge during the pre and post-program this might be related to the increased number of male nurses in the unit who attend training courses. This is in the same line with **Tamang et al. (2020)** who reported that a higher proportion of adequate knowledge was observed among males. This result contradicted a study done by **Al-Dossary et al. (2020)** in which female nurses exhibited an increased level of knowledge than male but this result should not be taken generalized as male nurses were only 13%.

As regards nurses' practices and gender, there was no statistically significant difference between male and female nurses during pre-program as the knowledge wasn't the only cause for malpractice there were other causes such as insufficient resources which is a global problem (**Olum, et al. 2020); (Bekele, Tolossa, Tsegaye, and Teshome, 2021); (Choi et al. 2020); (Buheji and Buhaid, 2020)**). But during the post-program period, there was a statistically significant difference between males and females regarding practices. Also, it might be due to an increased number of male nurses than female. This is in the same line with **Olum, et al. (2020)** who found that male nurses' practices increased than females but did not reach a significant level.

Among those nurses, the level of knowledge and practices were similar irrespective of their age or educational level. This is in the same line with **Olum, et al. (2020)** but contrary to the findings of a study done by **Al-Dossary et al. (2020)** who said that bachelor's degree nurses had better prevention of COVID-19 because they were qualified for early patient monitoring, assessment, and recovery.

Regarding the relation between years of experience and nurses' knowledge, nurses less than two years of experience had more knowledge than others but not reached a significant level. This might be because they were graduated recently and still had knowledge related to infection control and readiness to learn the latest information. This is in the same line with a study done by **Ejeh et al. (2020)** who confirmed that nurses with lower years of experience were more likely to seek knowledge than those with long years of experience.

The last relation between attending training courses and level of knowledge, there was a statistically significant difference at the pre-program period between those who attended training and those who didn't attend but at post-program period there was no statistically significant difference as both had a higher level of knowledge. This is in the same line with **Tamang et al. (2020)** who found that adequate knowledge was seen among those who attended training courses which confirmed the need for an educational program for health care workers especially nurses "the frontlines for COVID-19" to update their knowledge.

The findings of the current study illustrated that there was a negative significant correlation between nurses'

knowledge and practices at the pre-program period as nurses had knowledge but didn't have practices at the same level because of perceived barriers in the study setting like insufficient resources and overcrowded at the hemodialysis unit. This is in the same line with **Taghrir, Borazjani, & Shiraly, (2020)** who found that there was a negative correlation between medical students' knowledge and preventive measures of COVID-19. Contrary to the findings of **Tamang et al 2020; Ejeh et al. 2020** who found a positive correlation between nurses' knowledge and practices. While **Limbu, Piryani, & Sunny, (2020)** found that there was no correlation between knowledge and practices.

The findings of the current study at the post-program period reported that there was a weak positive correlation between nurses' level of knowledge and practices but not reached the significant level. this may be due to the small sample size. Nurses' knowledge is usually delivered into their clinical practices. In light of these findings, if nurses are aware of the best evidence of COVID-19 infection control measures, this will improve their performance and consequently the quality of care they provide and patient outcomes. Overall, the current study findings showed the positive effect of the educational program on nurses' knowledge and practices. Hence, These findings support the research hypothesis of the study.

### **Conclusions & Recommendations**

The educational program improved nurses' knowledge and practices. Therefore, nurses should periodically attend in-service training programs and refresh their training to maintain their knowledge and competency. COVID-19 courses should

be merged into the curriculum of undergraduate nursing students.

#### Limitations of the study:

This study involved a small size sample and was conducted only in one hospital. These factors limited the generalizability of the research findings. Besides, the researchers faced a challenge for going to the hospital several times due to the COVID-19 pandemic that forced the researchers to not assess nurses' knowledge and practices after 3 months of implementation of the educational program.

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#### Declaration of Conflicting Interests

The authors declared no potential conflicts of interest regarding the research or publication of the article.

#### References:

- Ahmadian, E., Hosseiniyan Khatibi, S. M., Razi Soofiyani, S., Abediazar, S., Shoja, M. M., Ardalan, M., & Zununi Vahed, S. (2020). Covid-19 and kidney injury: Pathophysiology and molecular mechanisms. *Reviews in medical virology*, e2176. Advance online publication. <https://doi.org/10.1002/rmv.2176>
- Akbarialiabad, H., Kavousi, S., Ghahramani, A., Bastani, B., & Ghahramani, N. (2020). COVID-19 and maintenance hemodialysis: a systematic scoping review of practice guidelines. *BMC nephrology*, 21(1), 1-9. <https://doi.org/10.1186/s12882-020-02143-7>
- Al-Dossary, R., Alamri, M., Albaqawi, H., Al Hosis, K., Aljeldah, M., Aljohan, M., ... & Almazan, J. (2020). Awareness, Attitudes, Prevention, and Perceptions of COVID-19 Outbreak among Nurses in Saudi Arabia. *International journal of environmental research and public health*, 17(21), 8269.
- Alrubaiee, G. G., Al-Qalah, T. A. H., & Al-Aawar, M. S. A. (2020). Knowledge, attitudes, anxiety, and preventive behaviours towards COVID-19 among health care providers in Yemen: an online cross-sectional survey. *BMC Public Health*, 20(1), 1-11.
- Bekele, D., Tolossa, T., Tsegaye, R., & Teshome, W. (2021). The knowledge and practice towards COVID-19 pandemic prevention among residents of Ethiopia. An online cross-sectional study. *Plos one*, 16(1), e0234585.
- Brouqui, P., Amrane, S., Million, M., Cortaredona, S., Parola, P., Lagier, J. C., & Raoult, D. (2021). Asymptomatic hypoxia in COVID-19 is associated with poor outcome. *International Journal of Infectious Diseases*, 102, 233-238.
- Buheji, M., & Buhaid, N. (2020). Nursing human factor during COVID-19 pandemic. *International Journal of Nursing*, 10(1), 12-24.
- Choi, K. R., Skrine Jeffers, K., & Cynthia Logsdon, M. (2020). Nursing and the novel coronavirus: Risks and responsibilities in a global outbreak.
- Coronavirus Disease 2019 (COVID-19) Outpatient Dialysis Facility Preparedness Assessment Tool. (2020, April 19). Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/downloads/COVID-19-outpatient-dialysis.pdf>
- Creput, C., Fumeron, C., Toledano, D., Diaconita, M., & Izzedine, H. (2020). COVID-19 in patients undergoing

- hemodialysis: prevalence and asymptomatic screening during a period of high community prevalence in a Large Paris Center. *Kidney medicine*, 2(6), 716-723. doi: [10.1016/j.xkme.2020.09.001](https://doi.org/10.1016/j.xkme.2020.09.001)
- Ejeh, F. E., Saidu, A. S., Owoicho, S., Maurice, N. A., Jauro, S., Madukaji, L., & Okon, K. O. (2020).** Knowledge, attitude, and practice among healthcare workers towards COVID-19 outbreak in Nigeria. *Heliyon*, 6(11), e05557.
- Interim Additional Guidance for Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed COVID-19 in Outpatient Hemodialysis Facilities. (2020).** Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/dialysis.html>
- International society of nephrology. (2020, October 1).** Recommendation Strategies for management of patients on dialysis. ISI International Society of Nephrology. <https://www.theisn.org/initiatives/covid-19/recommendations/#covid-19-in-patients-with-chronic-kidney-disease>
- Jain, U. (2020).** Effect of COVID-19 on the Organs. *Cureus*, 12(8).
- Kassem, A. M., Talaat, H., Shawky, S., Fouad, R., Amer, K., Elnagdy, T., ... & Musa, S. (2020).** SARS-CoV-2 infection among healthcare workers of a gastroenterological service in a tertiary care facility. *Arab Journal of Gastroenterology*, 21(3), 151-155. DOI: [10.1016/j.ajg.2020.07.005](https://doi.org/10.1016/j.ajg.2020.07.005).
- Limbu, D. K., Piryani, R. M., & Sunny, A. K. (2020).** Healthcare workers' knowledge, attitude and practices during the COVID-19 pandemic response in a tertiary care hospital of Nepal. *PLoS one*, 15(11), e0242126.
- Meijers B, Messa P, Ronco C. (2020).** Safeguarding the Maintenance Hemodialysis Patient Population during the Coronavirus Disease 19 Pandemic. *Blood purification*, 49(3), 259-264. doi: [10.1159/000507537](https://doi.org/10.1159/000507537)
- Mohammed, G. T., Khalil, S. S., Abo Elmagd, N. S., Gamal, N. M., & MohammedSaleh, Z. M. (2020).** COVID-19: Knowledge, Perception and Infection Control Practice of Health Care Workers (A Suggested Ward-based Educational Package). *Assiut Scientific Nursing Journal*, 8(22), 174-186.
- Nashwan, A. J., Abujaber, A. A., Mohamed, A. S., Villar, R. C., & Al-Jabry, M. M. (2021).** Nurses' willingness to work with COVID-19 patients: The role of knowledge and attitude. *Nursing Open*, 8(2), 695-701.
- Olum, R., Chekwech, G., Wekha, G., Nassozi, D. R., & Bongomin, F. (2020).** Coronavirus disease-2019: knowledge, attitude, and practices of health care workers at Makerere University Teaching Hospitals, Uganda. *Frontiers in public health*, 8, 181.
- Palm, F., & Koeners, M. P. (2018).** hypoxia in kidney disease. *Frontiers in physiology*, 9, 485. doi: [10.3389/fphys.2018.00485](https://doi.org/10.3389/fphys.2018.00485)
- Paterson, C., Gobel, B., Gosselin, T., Haylock, P. J., Papadopoulou, C., Slusser, K., ... & Pituskin, E. (2020).** Oncology nursing during a pandemic: critical reflections in the context of COVID-19. In *Seminars in oncology nursing* (p. 151028). WB Saunders. <https://doi.org/10.1016/j.soncn.2020.151028>
- Polit, D. F., & Beck, C.T. (2018).** Essentials of Nursing Research: Appraising Evidence for Nursing Practice. (9th Ed). Philadelphia: Lippincott Williams, & Wilkins.
- Safa, K. & Sise, M. (2020).** Kidney Disease and COVID-19: What Are the Risks?, Massachusetts General Hospital, Available online at [https://www.massgeneral.org/news/coronavirus/kidney-disease-and-covid-](https://www.massgeneral.org/news/coronavirus/kidney-disease-and-covid-19)

- [19](#) Accessed at 29 December, 2020 at 8:30 pm.
- Salas, J. B., Palacios, J., Dintrans, P. V., Madero-Cabib, I., Quilodran, R., Ceriani, A., & Meza, D. (2020).** Enablers and Barriers to Implement COVID-19 Measures in Long-term Care Facilities: A Mixed Methods Implementation Science Assessment in Chile.
- Saqlain, M., Munir, M. M., Rehman, S. U., Gulzar, A., Naz, S., Ahmed, Z., ... & Mashhood, M. (2020).** Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: a cross-sectional survey from Pakistan. *Journal of Hospital Infection*, 105(3), 419-423.
- Semerci, R., Kudubes, A. A., & Eşref, F. Ç. (2021).** Assessment of Turkish oncology nurses' knowledge regarding COVID-19 during the current outbreak in Turkey. *Supportive Care in Cancer*, 29(4), 1999-2006. <https://doi.org/10.1007/s00520-020-05700-w>
- Shu-Ching, C. H. E. N., Yeur-Hur, L. A. I., & Shioh-Luan, T. S. A. Y. (2020).** Nursing perspectives on the impacts of COVID-19. *Journal of Nursing Research*, 28(3), e85. <https://doi.org/10.1097/jnr.00000000000000389>
- Sperati, C. J. (2020, May 14).** Coronavirus: Kidney Damage Caused by COVID-19. Johns Hopkins Medicine. Available online at <https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-kidney-damage-caused-by-covid19> accessed at 23 December 2020.
- Suri, R. S., Antonsen, J. E., Banks, C. A., Clark, D. A., Davison, S. N., Frenette, C. H., Kappel, J. E., MacRae, J. M., Mac-Way, F., Mathew, A., Moist, L. M., Qirjazi, E., Tennankore, K. K., & Vorster, H. (2020).** Management of Outpatient Hemodialysis During the COVID-19 Pandemic: Recommendations From the Canadian Society of Nephrology COVID-19 Rapid Response Team. *Canadian journal of kidney health and disease*, 7, 2054358120938564. <https://doi.org/10.1177/2054358120938564>
- Taghrir, M. H., Borazjani, R., & Shiraly, R. (2020).** COVID-19 and Iranian medical students; a survey on their related-knowledge, preventive behaviors and risk perception. *Archives of Iranian medicine*, 23(4), 249-254.
- Tamang, N., Rai, P., Dhungana, S., Sherchan, B., Shah, B., Pyakurel, P., & Rai, S. (2020).** COVID-19: a National Survey on perceived level of knowledge, attitude and practice among frontline healthcare Workers in Nepal. *BMC public health*, 20(1), 1-10.
- Verma, A., Patel, A. B., Tio, M. C., & Waikar, S. S. (2020).** Caring for Dialysis Patients in a Time of COVID-19. *Kidney Medicine*. 2(6), 787-792 <https://doi.org/10.1016/j.xkme.2020.07.006>
- WHO Coronavirus (COVID-19) Dashboard. (2020).** World Health Organization. Retrieved December 23, 2020, from <https://covid19.who.int/table>.
- World Health Organization (2021), Health workforce; Nursing and midwifery. Accessed at 20 February 2021, Available online at: [https://www.who.int/hrh/nursing\\_midwifery/nursing-midwifery/en/](https://www.who.int/hrh/nursing_midwifery/nursing-midwifery/en/)