

Factors Associated with Health Care Providers' Adherence to COVID-19 Guidelines at Hemodialysis Units

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Abstract

coronavirus disease {COVID-19} appeared in 2019 and significantly disrupted many areas of life such as healthcare. Health care providers (HCPs), especially nurses and physicians, were on the front lines of fighting the pandemic, making it crucial to follow the recommended safety guidelines. However, many HCPs and hemodialysis (HD) patients were infected by the coronavirus, increasing concerns regarding factors associated with HCPs' adherence level to COVID-19 guidelines. **Objective:** The purpose of this study was to identify factors associated with health care providers' adherence to COVID-19 guidelines at hemodialysis units. **Setting:** The study was conducted at the HD units of the Main University Hospital and the Fever Hospital affiliated with the Ministry of Health, Alexandria, Egypt. **Materials and Method:** A descriptive research design was utilized. (60) health care providers showing up at the previously mentioned setting were recruited for the study. Health care providers (HCPs) knowledge of the COVID-19 guidelines structured interview questionnaire, health care providers' adherence to COVID-19 guidelines observational checklist, and factors associated with health care providers' adherence to COVID-19 guidelines structured interview questionnaire were utilized for data collection. **Results:** Showed most HCPs had unsatisfactory levels of knowledge and adherence toward COVID-19 prevention guidelines (61.7%, 55.0 %) respectively. Moreover, environmental factors were the most factors facing HCPs in their work with an overall percentage score of 78.75 ± 21.50 . Also, a highly statistically significant relation was found between HCPs' adherence to COVID-19 guidelines and associated factors such as organizational, environmental as well as individual factors ($p = 0.008, 0.005, 0.014$) respectively. **Conclusion:** Most of the studied HCPs had poor knowledge levels and unsatisfactory adherence levels toward COVID-19 guidelines, also the studied HCPs had identified and ranked the obstacles facing them as environmental, organizational, and individual factors.

Keywords: Health Care Providers, Adherence, COVID-19 Guidelines, Hemodialysis.

Introduction

Coronavirus disease {COVID-19} is an acute respiratory viral infection resulting from coronavirus 2 (SARS-CoV-2). The World Health Organization (WHO) announced the COVID-19 outbreak as a worldwide pandemic on March 11, 2020 (Etafa et al., 2021). Globally, there have been 629,978,289 confirmed cases of COVID-19 reported by WHO on November 8, 2022, including 6,582,023 deaths. As well 12,861,382,558 doses of vaccination have been given (WHO., 2022a). Egypt is one of the worst-affected nations in the Eastern Mediterranean region since the epidemic began. According to the WHO, Egypt reported 515 412 confirmed cases and 24 798 confirmed deaths on November 8, 2022. (WHO., 2022b).

In developing countries, such as Egypt, where infection control measures, screening,

and monitoring programs are limited and public health resources are inadequate, the COVID-19 pandemic response was demanding and challenging (Arafa et al., 2021). The Egyptian Ministry of Health (MOH) published a standardized and systematic guide for the diagnosis and treatment of COVID-19. This protocol classifies COVID-19-infected patients into mild, moderate, severe, and serious cases according to clinical manifestations. Severe and critical conditions require observation and management in intensive care units. Quarantine hospitals are prepared to implement this protocol (Medhat, & El Kassas, 2020).

Most COVID-19 deaths have been documented among elderly people, patients with associated comorbidities, and those who are immunosuppressed. Hemodialysis (HD) patients with COVID-19 experienced poor outcomes in some previous research reports (Banerjee et al., 2022). The mortality rate

among HD patients ranges from 20 percent to 30 percent worldwide which is 4 times more than non-dialysis patients. Patients on hemodialysis long life programs are more vulnerable to COVID-19 infection due to poor immunity, low socioeconomic status, old age, frequent visits to the hospital three times a week, and associated comorbidities including cardiovascular disease, diabetes mellitus, and hypertension which increase the severity of COVID-19 infection and cause poor prognosis among those group patients (El Karoui, & De Vriese, 2022).

Patients undergoing hemodialysis who have COVID-19 infection must continue coming to the hemodialysis facilities for regular dialysis as the lifesaving procedure for such group of patients, which increases the risk of spreading the infection to health team members, facility workers, and other HD patients (International Society of Nephrology, 2022). Health care providers (HCPs) are more likely to become infected than the general population due to their closer and more frequent interaction with infected patients especially those who are assigned to care for COVID-19 patients (Shatnawi et al., 2022). Currently, the COVID-19 virus had resistant to all known antiviral drugs, therefore, the implementation of infection control strategies and measures is a critical need to prevent the transmission of infection, especially in hemodialysis facilities. Many organizations have developed guidelines for fighting the COVID-19 virus in hemodialysis facilities and each dialysis center must adjust these guidelines to fit its specific protocols according to its own facilities, available resources, and circumstances. (Ibernon et al., 2020).

Implementation of infection control strategies and guidelines, as well as education of HD patients and HCPs, are essential to avoid the further spread of infection, such as social distancing and wearing face masks for suspected or confirmed COVID-19 patients. Also, respiratory hygiene, application of hand hygiene, and wearing proper personal protective equipment (PPE) by HCPs should be followed for those who are in direct and close contact with COVID-19-infected patients (Kliger et al., 2020). Separate rooms are recommended for the isolation of suspected or

confirmed infected patients with COVID-19 if available by keeping the door closed. If an isolation room is unavailable, patients who are suspected to be infected should be grouped on a scheduled isolation shift or have dialysis in a COVID-19 facility. In addition, routine disinfection of dialysis machines, chairs, equipment, and dialysis station surfaces between patients should be strictly applied (Kliger, & Silberzweig, 2020).

The dialysis unit's health care providers (HCPs) are responsible for coordinating and managing the care of HD patients, which requires knowledge, practical and leadership skills, especially in case of a pandemic, flexibility, as well as proper management are required to deal with challenges efficiently and achieve high quality of patient care with the best health outcomes (Lima et al., 2021). HCPs should follow infection control practices and adhere to protocols of care established for patients with COVID-19 to ensure both patient and HCPs' safety, and minimize the risk of infection (Nigri, & Silva, 2021 & Galende et al., 2022). The literature review revealed very limited studies to explore factors associated with HCPs' adherence to COVID-19 guidelines at hemodialysis units. The lack of these data necessitates conducting this study.

This study aimed to:

- Identify Factors Associated with Health Care Providers' Adherence to COVID-19 Guidelines at Hemodialysis Units.

Research Question:

- What are the factors associated with health care providers' adherence to COVID-19 guidelines at hemodialysis units?

Materials and Method

Materials

Research design:

A descriptive research design was utilized for this study.

Setting:

The study was conducted at the HD units of the Main University Hospital and the Fever Hospital affiliated to the Ministry of Health, Alexandria, Egypt.

Subjects:

All health care providers who participated in providing direct healthcare to patients with COVID-19 throughout the two shifts (morning, and evening), at the above-mentioned setting, were included in the study. Their numbers were 60 health care providers (5 physicians and 18 nurses from the Main University Hospital) and (10 physicians, 25 nurses, and 2 laboratory technicians from the Fever Hospital).

Tools of the study:

Three tools were utilized for data collection.

Tool I: Health Care Providers (HCPs) Knowledge of the COVID-19 Guidelines Structured Interview Questionnaire. This tool was developed by the researchers after reviewing the related literature; (Kassie et al., 2020, Abdel Wahed et al., 2020, Asemahagn, 2020). It was utilized to assess health care providers' knowledge of COVID-19 guidelines. It included two parts as follows:

Part I: This part included health care providers' sociodemographic and professional characteristics such as gender, age, educational status, marital status, profession, years of experience, hospital type, received training about COVID-19 infection prevention, and/or reading published materials about COVID-19 guidelines.

Part II: This part was designed to assess health care providers' knowledge of COVID-19 guidelines. It included 22 closed-ended questions that covered the main general information concerning COVID-19, the main clinical signs & symptoms, the incubation period, risk groups, mode of transmission, and ways of prevention.

Scoring system:

The health care provider's answers were no, yes, or don't know. Levels of knowledge were scored as {1} for the correct answer, and {0} for an incorrect or no-response answer. The total score value of knowledge level ranged from 0 to 22. The total score of knowledge was calculated and transformed into a percentage score as follows: health care providers who had

a knowledge score < 60% were considered as having an unsatisfactory knowledge level, while those who had knowledge \geq 60% were considered as having a satisfactory knowledge level.

Tool II: Health Care Providers' Adherence to COVID-19 Guidelines Observational Checklist:

This tool was developed by the researchers after reviewing the related literature and CDC guidelines as well as the WHO infection prevention and control guidelines (Australian Dental Association, 2021, WHO, 2021, CDC, 2021, Khut, 2020, WHO, 2020, Powell-Jackson et al., 2020, Department of Health & Human Services, 2020). It aimed to assess health care providers' adherence to COVID-19 guidelines in hemodialysis units. It included a total of six domains with a total of 33 items. These domains are:

- **Hand hygiene**, consisted of 9 items such as (hand hygiene before and after touching the patient, after contact with blood or other body fluids, after touching equipment and surfaces in the patient environment, and after doffing PPE, HCPs use the proper technique and duration for carrying out hand hygiene).
- **Respiratory hygiene/cough etiquette**, which consisted of 3 items including covering nose and mouth with tissue paper or bent elbow and upper arm when coughing or sneezing, applying hand hygiene after contact with respiratory secretions or any potentially contaminated objects with respiratory secretions, and giving patients suspected to be infected with COVID-19 a surgical mask to wear.
- **Use of personal protective equipment (PPE)**, which consisted of 7 items such as (HCPs appropriately use PPE including a face shield, face mask, eye goggles, clean gloves, gown, head cover, shoe covers, and use of respirator mask e.g. N95, to be worn if potential contact with blood or any body fluids, gloves are removed appropriately and discarded after contact with blood or body fluids. As well as changing gloves and performing hand hygiene before moving from a contaminated body part to a clean body part during patient care, then appropriately removing PPE and discarded after patient care).

- **Waste management**, included 4 item measures, HCPs follow the color coding of containers based on the type of biomedical discarding waste (BMW), do HCPs follow BMW separation policies of the non-hazardous, infectious, and sharp waste, do HCPs use appropriate PPE while contacting infectious waste and carry out hand hygiene after doffing the PPE, do HCPs prevent contamination between patients while handling items of patients with COVID-19 and other patients without COVID-19?
- **Environmental cleaning**, which included 4 items related to using of water and detergent to clean surfaces thoroughly, applying a disinfectant solution for COVID-19 contamination. Also, when using 70-90% ethanol or 0.1% sodium hypochlorite which one is efficient. For ethanol, do a minimum 1-minute contact time is advised, or disinfectant residue could be removed after the recommended contact time by rinsing with clean water if necessary.
- **Transmission-based precautions**, which included 6 items related to HCPs appropriate performance of transmission-based precautions? While for contact precautions, HCPs wear gloves and a gown before contact with the patient, for droplet precautions: HCPs wear a facemask within six feet distance from the patient, for airborne precautions: HCPs wear a respirator mask as N95 or other higher efficient respirator masks before entering the patient room, for a patient infected with COVID-19 or suspected to be infected: HCPs wear gloves, isolation gown, face shield or eye goggles and N95 mask or higher-efficient respirator if available, are HCPs touching their eyes, mouth or nose with bare hands or with the contaminated gloves?

Scoring system

Each domain with items was scored on a three-point Likert scale ranging from “always (two scores)”, “sometimes (one score)” or “never (zero score)”. The total score was then calculated and converted into percentage scores. Total percentage scores of $\geq 60\%$ were categorized as a satisfactory adherence level, while scores of $<60\%$ implied an unsatisfactory adherence level.

Tool III: Factors Associated with Health Care Providers' Adherence to COVID-19 Guidelines Structured Interview Questionnaire

This tool was developed by the researchers after reviewing the related literature (Amanya et al., 2021, Mae, & Angelo, 2021, &Houghton et al., 2020 & Njovu, 2016). It aimed to identify factors associated with HCPs adherence to COVID-19 guidelines. It consisted of 22 items in the form of statements grouped into three categories of factors namely, organizational factors (9 statements), environmental factors (4 statements), and individual factors (9 statements).

- Scoring System

Health care providers' answers were scored as Yes = (1 score) or No = (zero score). The total score was calculated and converted into percentages and then ranked.

Method

The study was conducted through the following steps:

- Approval from the Research Ethics Committee, Faculty of Nursing, Alexandria University was achieved.
- Official permission was obtained from the study settings' administrative staff after explaining the aim of the study to carry out the study.
- After reviewing the related literature, the study tools I, II, and III were developed by the researchers.
- Tools were tested for content and construct validity by 5 experts in the fields of medical-surgical nursing as well as infection prevention and control. The necessary modifications were made accordingly.
- Reliability of the tools was tested by using Cronbach's Alpha Coefficient Test, its results were 0.871 for tools I & II and 0.896 for tool III, which indicated that the tools were reliable.
- A pilot study was carried out on 10% of the total studied health care providers to ascertain the feasibility, clarity, and applicability of the developed tools, then the essential modifications were introduced.

Data collection and implementation of the study:

- ✓ Each health care provider was interviewed for 30-45 minutes to collect the sociodemographic and professional characteristics and to assess their knowledge about COVID-19 guidelines by using tool I, as well as to identify factors associated with HCPs' adherence to COVID-19 guidelines by using tool III.
- ✓ All health care providers were observed during the morning and the evening shift using tool II to assess HCPs' adherence to COVID-19 guidelines.
- ✓ The data were collected daily and over a period of four months from the end of November 2021 to the end of March 2022.

Ethical Considerations:

- ✓ An ethical committee permission was obtained to conduct the study. The purpose of the study was explained to all the studied subjects, and the informed consent was signed before participation by all of them.
- ✓ Anonymity and privacy were asserted.
- ✓ Confidentiality of collected data was assured.
- ✓ The health care providers were informed that participation in the study is voluntary, and they can withdraw at any time.

Statistical analysis of the data

- ✓ Statistical analysis was done using the IBM SPSS statistics program version 21 (Patel, 2021). Qualitative data were described using frequency and percent, range {minimum and maximum}, mean, standard deviation, and median. To verify the normality of distribution, the Kolmogorov-Smirnov test was used.
- ✓ The Chi-square test was used to study the significant association between two categorical variables.
- ✓ Fisher exact and Monte Carlo significance was used if more than 20% of the total expected cell counts <5.
- ✓ The Mann-Whitney test was used for abnormally distributed quantitative variables, to compare two studied categories, while the Kruskal-Wallis test was used to compare more than two studied categories.
- ✓ All statistical tests were judged at a 0.05 significance level.

Results

Table (1): Shows the Frequency Distribution of the Studied Health Care Providers (HCPs) According to Their sociodemographic and Professional Characteristics.

It was noticed that most of the studied HCPs were females (83.3%) and most of them (55.0%) were less than 30 years old with a mean of 32.22 ± 9.99 years. Also, around two-thirds of them were married (65.0%). According to their educational level, it was observed that more than half of the HCPs (63.3%) had a technical institute, while only a few (1.7%) of them had Ph.D. degrees. Moreover, more than two-thirds of the studied HCPs (71.7%) were nurses. Regarding years of experience, (71.7%) of the studied HCPs had < 10 years of experience. In relation to receiving training on infection prevention regarding the COVID-19 guidelines, about one-quarter of the studied HCPs (25.0%) received training, while three-quarters of them (75.0%) did not attend any training. Additionally, more than half of them did not read any materials about COVID-19 guidelines, also they reported not published materials about COVID-19 guidelines at the workstations (58.3%, 68.3%) respectively.

Table (2): Shows the Distribution of the Studied Health Care Providers in Relation to Their Knowledge of COVID-19 Guidelines.

It could be noticed from table (2) that most studied HCPs (61.7%) had an unsatisfactory level of knowledge about COVID-19 preventive guidelines, while more than one-third of them (38.3%) had a satisfactory level of knowledge with a mean percent score of (57.35 ± 19.30).

Table (3): Displays Distribution of The Studied Health Care Providers Regarding Their Adherence to COVID-19 Guidelines.

The table showed that hand hygiene was the highest reached level of adherence (58.3%) while the lowest adherence level was in respiratory hygiene/cough etiquette (16.7%). Moreover, only (45.0%) of the studied health care providers had a satisfactory level of adherence regarding COVID-19 guidelines in

the overall observed application of the guidelines with a mean percent score of (47.89 ± 14.50) .

Table (4) Reveals the Frequency Distribution of Factors Associated with Health Care Providers' Adherence to COVID-19 Guidelines. As regards organizational factors, a large percentage of HCPs reported that all organizational factors were facing them. There was an increased number of patients, inadequate funding and material resources, inadequate human resources, no update to infection control guidelines, frustration with COVID-19 guidelines training, inadequate support and encouragement from hospital management, inadequate education and training program for HCPs on COVID-19 guidelines, lack of supervision and ineffective communication, with inadequate hospital infrastructure (100.0%, 83.3%, 78.3%, 76.7%, 71.7%, 68.3%, 66.7%, 65.0%, 60.0 %) respectively.

Regarding environmental factors, revealed that most HCPs reported that all environmental factors listed are factors facing and hindering them from applying COVID-19 guidelines as work overload, emergency situations, no role model, and patient discomfort (90.0%, 90.0%, 75.0%, 60.0%) respectively.

Regarding individual factors, the table clarified that most of the studied HCPs reported that all individual factors were faced including the negative effects of using PPE, lack of time due to over load, tiredness and psychological factors, implementation of COVID-19 guidelines is time-consuming, forgetting to follow COVID-19 guidelines, negative attitude of HCPs, lack of clinical experience, lack of knowledge, perceived COVID-19 infection as risk while being at work (86.7% , 83.3% , 73.3% ,73.3% , 70.0%, 60.0% , 58.3 % , 53.3%, 31.7 %) respectively.

Table (5) & Fig 1: Shows Descriptive Analysis of % Score of Factors associated

with Health Care Providers' Adherence to COVID -19 Guidelines. It revealed that environmental factors were the most associated factors facing HCPs in their work with an overall percentage score of (78.75 ± 21.50) , then organizational factors with an overall percentage score of (66.67 ± 18.64) , and finally the individual factors were the least one facing them with an overall percentage score of (65.56 ± 20.73) .

Table (6): Shows the Relation Between the Sociodemographic, Professional Characteristics of HCPs and Factors associated with HCPs' Adherence to COVID-19 Guidelines. It was found that there was a statistically significant relationship between age, educational status, profession, hospital type, and environmental factors with $(P= 0.020, 0.007, 0.004, 0.026)$ respectively. There was also a statistically significant relationship between years of experience and organizational factors only with $(P= 0.048)$. No significant relation was found between the sociodemographic, and professional characteristics of HCPs and the individual factors.

Table (7): Shows the Relation Between the Sociodemographic, Professional Characteristics of HCPs, and Their Adherence to COVID-19 Guidelines. It was found that there is no statistically significant relationship between the sociodemographic, and professional characteristics of HCPs, and their adherence level to COVID-19 guidelines application.

Table (8): Reveals the Relation Between Health Care Providers' Adherence to COVID-19 Guidelines Application and Associated Factors. The table demonstrated a highly statistically significant relationship between HCPs' adherence to COVID-19 guidelines and organizational, environmental as well as individual factors associated with it $(p = 0.008, 0.005, 0.014)$ respectively.

Table (1): The Frequency Distribution of The Studied Health Care Providers (HCPs) According to Their sociodemographic and Professional Characteristics (n =60)

sociodemographic and professional characteristics	No.	%
Gender		
Male	10	16.7
Female	50	83.3
Age		
20 - <30	33	55.0
30 - 40	17	28.3
>40	10	16.7
Min. – Max.	22.0 – 58.0	
Mean ± SD.	32.22 ± 9.99	
Median	28.50	
Marital status		
Married	39	65.0
Single	14	23.3
Divorced	4	6.7
Widow	3	5.0
Educational status		
Diploma	6	10.0
Bachelor's degree	8	13.3
Technical Institute	38	63.3
Master's Degree	7	11.7
Ph.D. degrees	1	1.7
Profession		
Medical doctors	15	25.0
Nurses	43	71.7
Laboratory technician	2	3.3
Years of experience in the setting		
<10	43	71.7
10-20	8	13.3
>20	9	15.0
Min. – Max.	1.0 – 38.0	
Mean ± SD.	8.63 ± 9.24	
Median	4.50	
Hospital type		
Fever Hospital (Ministry of Health Hospital)	42	70.0
Main University Hospital	18	30.0
Received training on infection prevention/COVID-19		
No	45	75.0
Yes	15	25.0
If yes (n = 15)		
One	11	73.3
Two times	1	6.7
Three or more	3	20.0
Read materials on COVID-19 guidelines		
No	35	58.3
Yes	25	41.7
Have COVID-19 guidelines at a workstation		
Don't have	41	68.3
Have	19	31.7

SD: Standard deviation

Table (2): The Distribution of the Studied Health Care Providers in Relation to Their Knowledge of COVID-19 Guidelines (n = 60)

Knowledge	No.	%
Unsatisfactory (<60%)	37	61.7
Satisfactory (≥60%)	23	38.3
Total score	(0 – 22)	
Min. – Max.	6.0 – 20.0	
Mean ± SD.	12.62 ± 4.25	
Median	11.0	
% Score		
Min. – Max.	27.27 – 90.91	
Mean ± SD.	57.35 ± 19.30	
Median	50.0	

Table (3): Distribution of The Studied Health Care Providers Regarding Their Adherence to COVID-19 Guidelines (n =60)

COVID-19 Guidelines	Adherence to COVID-19 Guidelines					
	Not adherent (<60%)		Adherent (≥60%)		Total score	% Score
	No.	%	No.	%	Mean ± SD.	Mean ± SD.
Hand hygiene	25	41.7	35	58.3	10.02 ± 4.28	55.65 ± 23.76
Respiratory hygiene/cough etiquette	50	83.3	10	16.7	1.95 ± 1.49	32.50 ± 24.82
Use of Personal Protective Equipment (PPE)	31	51.7	29	48.3	7.62 ± 3.71	54.40 ± 26.53
Waste management	42	70.0	18	30.0	3.45 ± 1.72	43.12 ± 21.52
Environmental cleaning	40	66.7	20	33.3	3.27 ± 1.98	40.83 ± 24.77
Transmission-Based Precautions	49	81.7	11	18.3	4.35 ± 1.52	43.50 ± 15.16
Overall Adherence	33	55.0	27	45.0	30.65 ± 9.28	47.89 ± 14.50

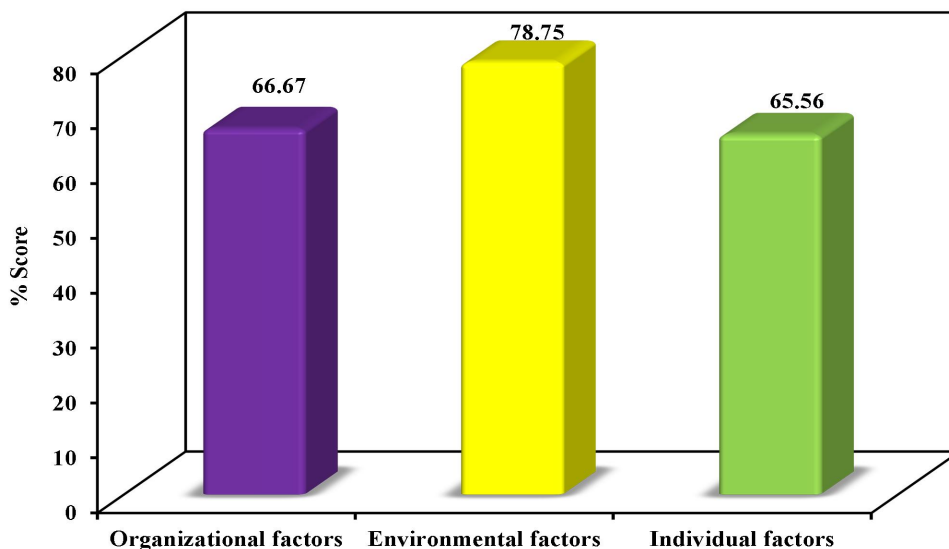
Table (4): Reveals the Frequency Distribution of Factors Associated with Health Care Providers' Adherence to COVID-19 Guidelines (n =60)

Factors associated with health care provider's adherence to COVID-19 Guidelines	No		Yes		Mean ± SD.	Rank
	No.	%	No.	%		
Organizational factors						
• No update to infection control guidelines related to COVID-19	14	23.3	46	76.7	0.77 ± 0.43	4
• Inadequate funding and material resources e.g., gloves, gown, mask	10	16.7	50	83.3	0.83 ± 0.38	2
• Inadequate human resources	13	21.7	47	78.3	0.78 ± 0.42	3
• Increase the number of patients	0	0.0	60	100.0	1.00 ± 0.00	1
• Inadequate education and training program for health workers on COVID-19 guidelines	20	33.3	40	66.7	0.33 ± 0.48	7
• Frustration with the frequency of COVID-19 guidelines training	17	28.3	43	71.7	0.72 ± 0.45	5
• Inadequate support and encouragement from hospital management	19	31.7	41	68.3	0.32 ± 0.47	6
• Lack of supervision and ineffective communication	21	35.0	39	65.0	0.65 ± 0.48	8
• Inadequate hospital infrastructure	24	40.0	36	60.0	0.60 ± 0.49	9
Environmental factors						
• Work overload	6	10.0	54	90.0	0.90 ± 0.30	1
• Patient discomfort (patient may experience distress and anxiety)	24	40.0	36	60.0	0.60 ± 0.49	4
• No role model	15	25.0	45	75.0	0.75 ± 0.44	3
• Emergency situations	6	10.0	54	90.0	0.90 ± 0.30	1
Individual factors						
• Forget to follow COVID-19 guidelines	18	30.0	42	70.0	0.70 ± 0.46	5
• Lack of knowledge	28	46.7	32	53.3	0.53 ± 0.50	8
• Lack of time (too busy)	10	16.7	50	83.3	0.83 ± 0.38	2
• Negative attitude of health care providers	24	40.0	36	60.0	0.60 ± 0.49	6
• Negative effects of using PPE (such as skin rash, the difficulty of breathing)	8	13.3	52	86.7	0.87 ± 0.34	1
• Tiredness and psychological factors	16	26.7	44	73.3	0.73 ± 0.45	3
• Lack of clinical experience	25	41.7	35	58.3	0.58 ± 0.50	7
• Implementation of COVID-19 guidelines is time-consuming	16	26.7	44	73.3	0.73 ± 0.45	3
• Perceived COVID-19 infection risk while being at work	41	68.3	19	31.7	0.32 ± 0.47	9

Table (5): Descriptive Analysis of % Score of Factors associated with Health Care Providers' Adherence to COVID-19 Guidelines (n = 60)

Rank	Factors	Min. – Max.	Mean ± SD.	Median	% Score
1-	Environmental factors	0.0 – 4.0	3.15 ± 0.86	3.0	78.75 ± 21.50
2-	Organizational factors	2.0 – 9.0	6.0 ± 1.68	6.0	66.67 ± 18.64
3-	Individual factors	1.0 – 8.0	5.90 ± 1.87	6.0	65.56 ± 20.73

SD: Standard deviation

**Fig (1):** Descriptive Analysis of % Score of Factors associated with Health Care Providers' Adherence to COVID-19 Guidelines (n = 60).**Table (6):** The Relation Between the Sociodemographic, Professional Characteristics of HCPs and Factors associated with HCPs' Adherence to COVID-19 Guidelines. (n=60).

Sociodemographic and professional characteristics	Factors associated with HCPs' Adherence to COVID-19 Guidelines					
	Organizational factors		Environmental factors		Individual factors	
	Mean ± SD.	Median	Mean ± SD.	Median	Mean ± SD.	Median
Gender						
Male	74.44 ± 20.98	88.89	85.0 ± 26.87	100.0	63.33 ± 20.98	66.67
Female	65.11 ± 17.96	55.56	77.50 ± 20.36	75.0	66.0 ± 20.87	66.67
U (p)	176.500 (0.133)		178.50 (0.126)		226.0 (0.627)	
Age						
20-<30	60.94 ± 17.37	55.56	89.71 ± 17.81	100.0	61.62 ± 24.55	66.67
30-40	72.55 ± 17.18	77.78	73.48 ± 22.48	75.0	69.28 ± 13.91	77.78
>40	75.56 ± 20.15	77.78	77.50 ± 18.45	75.0	72.22 ± 14.10	72.22
H (p)	5.933 (0.051)		7.833* (0.020*)		1.295 (0.523)	
Marital status						
Married	68.95 ± 21.35	66.67	77.56 ± 22.06	75.0	62.11 ± 23.32	66.67
Single	65.08 ± 12.97	66.67	82.14 ± 20.64	87.50	72.22 ± 13.61	72.22
Divorced	58.33 ± 5.56	55.56	87.50 ± 25.0	100.0	75.0 ± 5.56	77.78
Widow	55.56 ± 0.0	55.56	66.67 ± 14.43	75.0	66.67 ± 19.25	77.78
H (p)	2.672 (0.445)		3.011 (0.390)		2.093 (0.523)	
Educational status						
Diploma	72.22 ± 19.56	66.67	79.17 ± 10.21	75.0	72.22 ± 9.30	77.78
Bachelor's degree	58.33 ± 15.43	55.56	59.38 ± 18.60	62.50	63.89 ± 27.70	66.67
Technical Institute	65.50 ± 19.12	61.11	92.86 ± 18.90	100.0	64.04 ± 21.83	66.67

Sociodemographic and professional characteristics	Factors associated with HCPs' Adherence to COVID-19 Guidelines					
	Organizational factors		Environmental factors		Individual factors	
	Mean ± SD.	Median	Mean ± SD.	Median	Mean ± SD.	Median
Master's degree	77.78 ± 16.97	88.89	80.92 ± 21.3	75.0	71.43 ± 14.14	77.78
PHD	66.67		50.00		55.56	
H (p)	4.601 (0.331)		14.082* (0.007*)		1.424 (0.840)	
Profession						
Physicians	69.63 ± 17.55	66.67	91.67 ± 18.09	100.0	71.85 ± 9.26	77.78
Nurse	65.89 ± 18.53	55.56	75.58 ± 20.04	75.0	65.12 ± 21.90	66.67
Laboratory technician	61.11 ± 39.28	61.11	50.0 ± 35.36	50.0	27.78 ± 23.57	27.78
H (p)	0.521 (0.771)		11.143* (0.004*)		4.795 (0.091)	
Years of experience in the setting						
<10	63.05 ± 18.07	55.56	78.49 ± 22.21	75.0	63.05 ± 22.71	66.67
10-20	70.83 ± 15.64	66.67	78.13 ± 20.86	75.0	70.83 ± 14.47	77.78
>20	80.25 ± 20.62	88.89	80.56 ± 20.83	75.0	72.84 ± 12.56	77.78
H (p)	6.087 (0.048)*		0.077 (0.962)		1.349 (0.509)	
Hospital type						
Fever hospital	67.20 ± 18.52	66.67	82.74 ± 19.51	75.0	69.31 ± 17.32	77.78
University Hospital	65.43 ± 19.39	55.56	69.44 ± 23.57	75.0	56.79 ± 25.53	55.56
U (p)	365.0 (0.829)		250.0 (0.026)*		273.0 (0.084)	
Received training on infection prevention/COVID-19						
No	64.94 ± 17.24	55.56	76.11 ± 21.95	75.0	66.67 ± 21.06	77.78
Yes	71.85 ± 22.17	77.78	86.67 ± 18.58	100.0	62.22 ± 20.05	66.67
U (p)	279.50 (0.307)		242.0 (0.079)		282.50 (0.338)	
Read materials on COVID-19 guidelines						
No	67.94 ± 19.01	55.56	78.57 ± 16.21	75.0	65.08 ± 21.41	66.67
Yes	64.89 ± 18.34	66.67	79.0 ± 27.65	100.0	66.22 ± 20.15	66.67
U (p)	417.50 (0.757)		385.0 (0.396)		434.50 (0.963)	
Have COVID-19 guidelines at workstation						
Don't have	68.29 ± 17.84	66.67	78.66 ± 19.01	75.0	66.67 ± 15.71	66.67
Have	63.16 ± 20.30	55.56	78.95 ± 26.70	75.0	63.16 ± 29.18	77.78
U (p)	325.00 (0.290)		353.50 (0.537)		358.0 (0.610)	

SD: Standard deviation

U: Mann Whitney test

H: H for Kruskal Wallis test

p: p value for Relation between % score of factors and Socio-demographic and professional

*: Statistically significant at $p \leq 0.05$

Table (7): The Relation Between the Sociodemographic, Professional Characteristics of HCPs, and Their Adherence to COVID-19 guidelines. (n =60)

Sociodemographic and professional characteristics	HCPs Adherence to COVID-19 guidelines				Test of Sig.	p
	Not adherent (<60%) (n = 33)		Adherent (≥60%) (n = 27)			
	No.	%	No.	%		
Gender						
Male	4	12.1	6	22.2	$\chi^2=$ 1.091	FEp= 0.322
Female	29	87.9	21	77.8		
Age					$\chi^2=$ 3.841	0.147
20-<30	15	45.5	18	66.7		
30-40	10	30.3	7	25.9		
>40	8	24.2	2	7.4		
Marital status					$\chi^2=$ 0.908	MCp= 0.928
Married	22	66.7	17	63.0		
Single	8	24.2	6	22.2		
Divorced	2	6.1	2	7.4		
Widow	1	3.0	2	7.4		
Educational status					$\chi^2=$ 3.240	MCp= 0.540
Diploma	5	15.2	1	3.7		
Bachelor's degree	4	12.1	4	14.8		
Technical Institute	20	60.6	18	66.7		
Master's Degree	4	12.1	3	11.1		
PHD	0	0.0	1	3.7		
Profession					$\chi^2=$ 2.228	MCp= 0.383
Medical doctors	9	27.3	6	22.2		
Nurse	24	72.7	19	70.4		
Laboratory technician	0	0.0	2	7.4		
Years of experience in the setting					$\chi^2=$ 2.178	MCp= 0.360
<10	22	66.7	21	77.8		
10-20	4	12.1	4	14.8		
>20	7	21.2	2	7.4		
Hospital type					$\chi^2=$ 0.003	0.955
Fever hospital	23	69.7	19	70.4		
University hospital	10	30.3	8	29.6		
Received training on infection prevention/COVID-19					$\chi^2=$ 0.561	0.454
No	26	78.8	19	70.4		
Yes	7	21.2	8	29.6		
Read materials on COVID-19 guidelines					$\chi^2=$ 0.433	0.511
No	18	54.5	17	63.0		
Yes	15	45.5	10	37.0		
Have COVID-19 guidelines at work station					$\chi^2=$ 3.704	0.054
Don't have	26	78.8	15	55.6		
Have	7	21.2	12	44.4		

χ^2 : Chi-square test MC: Monte Carlo FE: Fisher Exact

p: p-value for Relation between sociodemographic and professional characteristics of HCPs and Their adherence to COVID-19 guidelines.

*: Statistically significant at $p \leq 0.05$

Table (8): The Relation Between Health Care Providers' Adherence to COVID-19 Guidelines Application and Associated Factors. (n =60).

Factors	HCPs' adherence to COVID-19 guidelines		Test of Sig.	p
	Not adherent (<60%) (n = 33)	Adherent (≥60%) (n = 27)		
Organizational factors				
Mean ± SD.	73.06 ± 18.22	58.85 ± 16.25	U=	0.008*
Median	66.67	55.56	273.0*	
Environmental factors				
Mean ± SD.	86.36 ± 14.10	69.44 ± 25.32	U=	0.005*
Median	75.0	75.0	269.0*	
Individual factors				
Mean ± SD.	72.05 ± 15.74	57.61 ± 23.48	U=	0.014*
Median	77.78	66.67	283.0*	

SD: Standard deviation

U: Mann Whitney test

p: p-value for Relation between health care providers' adherence to COVID-19 guidelines application and factors affecting it

*: Statistically significant at $p \leq 0.05$

Discussion

The health care providers (HCPs) are a high-risk population for healthcare-acquired infections (HCAIs) and they can also act as a vector for infection transmission. On the other hand, hemodialysis (HD) patients are also vulnerable to becoming infected due to impaired immunity, associated comorbidities, and invasive procedures. Therefore, protecting both HCPs and patients on HD long life program from infection are the main priority at HD units. Application of COVID-19 guidelines and adherence to the preventive measures are necessary to limit the transmission of coronavirus disease (Ibernon, et al., 2020).

The main findings of the current study indicated that most of the studied HCPs were females, married, and graduates from the technical institutes of nursing with a mean age of 32.22 ± 9.99 years old. This finding is supported by (Arslanca et al., 2021, & Sass et al., 2020) who found similar findings in a previous study. The present study also demonstrated that most studied HCPs at HD units were nurses and most of them had less than 10 years of experience. This result agrees with (Hashemi et al., 2018) who reported that nearly half of HCPs were nurses and all HCPs had to experience at least 3 years in practice at the HD unit. This finding highlights the fundamental role of nurses in managing patients on HD long life programs and fighting coronavirus infection.

In relation to the training program received about controlling COVID-19 infection, the current study results showed that most HCPs did not attend any in-service training program and did not read any materials about COVID-19 guidelines. Also, they reported the absence of COVID-19 published guidelines at the workstation. These results may be due to a shortage of HCPs and an increase in the number of patients, so there is not enough time to attend training programs or read the instructions that related to COVID-19. Also, these results stand in line with the findings of (Manandhar et al., 2017) who reported a lack of formal training programs for HCPs in dialysis facilities, especially in governmental hospitals.

Regarding health care providers' level of knowledge about COVID-19 guidelines at HD units, the current study revealed that most of the studied HCPs had an unsatisfactory level of knowledge about COVID-19 guidelines and/or preventive measures. This may be due to the lack of published guidelines about COVID-19 at the workstation, and HCPs did not read any materials about covid-19 guidelines as reported by most of the HCPs included in the study. Also, most of them had intermediate education, as they were graduates from technical nursing institutes. This agrees with studies done by (Osman, et al., 2021) who illustrated that more than half of the studied nurses had poor knowledge about infection prevention and control (IPC) practices in the

hemodialysis units prior to the implementation of the educational program.

Concerning health care providers' adherence to COVID-19 guidelines at HD units, the results of the current study revealed that more than half of HCPs had an unsatisfactory level of adherence to overall COVID-19 guidelines at HD units. It could be due to a lack of knowledge about guidelines and preventive measures for COVID-19 infection which affected HCP's practices and adherence negatively, also may be due to a lack of training, inadequate supervision from responsible personnel, as well as a lack of policy regarding actions that should be taken toward HCPs who did not adhere to COVID-19 guidelines. This finding contradicts the finding of (Almohammed et al., 2021) who illustrated that most studied HCPs demonstrated proper compliance with IPC practices during the COVID-19 pandemic.

When the COVID-19 pandemic started, hand hygiene became essential among the frontline of HCPs who oversee caring for patients. It should be followed by all HCPs regardless of the type of infection to prevent the occurrence of HCAs and enhance both HCPs and patients' safety (AlSaihati et al., 2022). The results reflected that hand hygiene had the highest level of adherence among all COVID-19 guidelines. It could be justified by the availability of sinks and hand hygiene supplies, published posters about hand hygiene techniques, as well as hand sanitizers placed in common areas at HD units. This finding is supported by the finding of (Ragusa et al., 2021) who found that HCPs who adherence to hand hygiene, grew over the last 6 years from 2015 to 2020, but is still insufficient. Moreover, during the COVID-19 pandemic, the adherence level to hand hygiene is significantly improved.

On the other hand, the results of this study revealed that respiratory hygiene/cough etiquette had the lowest level of adherence among most of the studied HCPs. The reason may be a lack of knowledge about respiratory hygiene that should be applied. This finding conflicts with (Alshammari et al., 2021) who found that half of the participants usually adhere to respiratory hygiene instructions and cover the nose and the mouth with tissue paper or elbow while coughing or sneezing.

In relation to using of (PPE) and adherence to waste management guidelines, the results displayed that most HCPs had an unsatisfactory level of adherence. It may be due to work overload resulting in inadequate time for wearing PPE, unavailability of PPE, and lack of awareness about the importance of using PPE. Moreover, a lack of published waste management guidelines. This was supported by the ranking of environmental and organizational factors as a barrier for HCPs (fig.1) & table (5).

Similarly, (Lubbab et al., 2022, & Mohamed et al., 2021) concluded that most HCPs had low compliance with using PPE at HD units. However, this finding contradicts (Soliman et al., 2018) who reported that waste and sharps were appropriately separated and discarded in the proper waste container in HD units which indicated a high level of awareness of HCPs about the probability of acquiring HCAs from waste and sharps especially.

Maintenance of a safe hospital environment and applying transmission-based precautions are considered fundamental factors for eliminating the risk of acquiring infection, especially in HD units. (Amer et al., 2015). Regarding the environmental cleaning practices and transmission-based precautions, the results revealed an unsatisfactory adherence levels among more than half of the studied HCPs, it may be due to lack of supervision from the infection control team, negligence, lack of supplies, inadequate information about transmission modes of COVID-19, the importance of using both standard and transmission-based precautions to combat infectious diseases, also inadequate training of HCPs. This finding is consistent with (Tabash et al., 2018 & Karkar, 2016) who reported that most HCPs in their study did not adhere to transmission-based precautions during the COVID-19 pandemic, also inadequate environmental cleaning practices at HD units were significantly observed.

A variety of challenges for IPC practices in health care institutions face HCPs. Concerning environmental factors, the present study revealed that it was ranked at the top of barriers facing the present studied HCPs. These factors were hindering them from applying COVID-19 guidelines. These factors were ranked as work

overload, emergency situations, no role model, and patient discomfort. Also, a highly statistically significant relation was found between HCPs' adherence to COVID-19 guidelines and environmental factors. It could be due to increased workload and emergency situations at HD units causing physical and emotional stress for HCPs resulting in negligence or forgetting to apply and adhere to the COVID-19 guidelines. This result is compatible with the result of the study done by (Njovu, 2016) who listed the same factors in his study.

Regarding the organizational factors, the present study findings revealed that all organizational factors listed are facing the studied HCPs; it occupied the second level in ranking directly after the environmental factors. In addition, a high statistically significant relation was found between HCPs' adherence level to COVID-19 guidelines and the organizational factors. It indicated that organizational factors affected the overall level of adherence to COVID-19 guidelines negatively.

The organizational factors were ranked as increased patients' number, inadequate funding and supplies, shortage of HCPs, no updating of the infection control guidelines, frustration with the frequency of COVID -19 infection, lack of support and encouragement from the hospital management staff, inadequate education and training programs about COVID-19 guidelines, lack of supervision and ineffective communication, and finally inadequate hospital infrastructure.

This finding agrees with (Mersha et al., 2021, & Houghton et al., 2020) who found that inadequate PPE and supplies, lack of training, ignorance and negligence attitude of HCPs, improper hospital infrastructure, ineffective communication about infection control as well as the inadequate motivation of HCPs were the main barriers to practice COVID-19 guidelines. Furthermore, it is supported by (Shah et al., 2022) who recommended proper training programs and provided updated information and guidance from realistic sources to HCPs for enhancing their application of preventive measures and practices during the management of patients with COVID-19.

In relation to individual factors, the study clarified that individual factors including negative

effects of using PPE, lack of time, tiredness, psychological factors, implementation of COVID-19 guidelines are time-consuming according to HCPs opinion, forgetting to follow COVID-19 guidelines, negative attitude of health care providers, lack of clinical experience, lack of knowledge, perceived COVID-19 as infection risk while being at work as reported by most of the studied HCPs and a statistically significant relation was found between HCPs adherence level to COVID-19 guidelines and the individual factors.

This finding is consistent with (Thatrimontrichai et al., 2021) who stated that individual factors are important and influence HCPs' adherence level to COVID-19 guidelines. However, this finding disagrees with (Latif et al., 2022) who found that a positive attitude of HCPs, having more updated knowledge, and fear of acquiring COVID-19 infection increases the probability of adherence to guidelines and practicing the application of the preventive measures.

Concerning the relation between the sociodemographic, and professional characteristics of HCPs, and factors associated with HCPs' adherence level to COVID-19 guidelines, the current study illustrated that a statistically significant association was found between age and environmental factors. It may be due to most HCPs being less than 30 years old which affects their ability to deal with patient discomfort and emergency situations due to lack of skills and experience, and the absence of role models as reported by most of the studied HCPs. In addition, the results showed a statistically significant relationship between educational status and environmental factors. It could be due to a lack of knowledge as most HCPs hold technical institutes of nursing.

The present study also reflected a statistically significant association between the profession and environmental factors. It could be rationalized by a shortage of HCPs, especially physicians, and an increased workload in HD units during the COVID-19 pandemic. Furthermore, a statistically significant association was found between hospital type and environmental factors. This finding may be due to a lack of physical resources and supplies resulting from the reallocation of all available resources in hospital response to

COVID-19 infection, especially in Fever Hospital. Additionally, Fever hospital is considered the main health setting for dealing with infectious diseases, especially in emergency situations, and increased patient numbers, that's why HCPs had significant a challenge with applying and adherent to covid 19 guidelines. The results also reflected a statistically significant relationship between years of experience and organizational factors. HCPs who have more years of experience may be more reluctant to change.

Concerning the relationship between the sociodemographic, and professional characteristics of HCPs and their adherence level to COVID-19 guidelines application. The results showed no statistically significant relationship between them. This finding contradicts (**Mortada et al., 2021, & Firouzbakht et al., 2021**) who found a highly statistically significant relation between some demographic characteristics of HCPs participated as gender, profession, level of education, and adherence to COVID-19 preventive measures due to the risk perception of infection which enhances the preventive behaviors.

Identifying factors associated with adherence to COVID-19 guidelines is useful for developing policies and effective intervention programs to overcome these barriers, improving HCPs' adherence level to the guidelines and IPC practices, maintaining safety for both HCPs and patients, as well enhancing the quality of health care services related to COVID-19, as well as achieving better health outcomes (**Fauk et al., 2022**).

Conclusion

In conclusion, the current study findings document that most studied HCPs had an unsatisfactory knowledge level and unsatisfactory adherence levels toward COVID-19 guidelines, also the studied HCPs had identified and ranked the barriers facing them as environmental, organizational, and individual barriers. High statistically significant relations were found between HCPs' adherence level to COVID-19 guidelines, as well as the environmental, organizational, and individual factors associated with it.

Recommendations

Based on the study results, the following recommendations are suggested:

- Improve HCPs' awareness of COVID-19 guidelines by attending IPC training courses and workshops.
- Health care providers should read more about IPC guidelines, especially that related to COVID-19 guidelines.
- Applying infection control guidelines should be a habit and a personal attitude among HCPs.
- Develop and provide a booklet and posters about COVID-19 guidelines for HCPs in hemodialysis units.
- Motivate HCPs to apply COVID-19 guidelines by supporting and rewarding HCPs who apply them.
- Revise and update infection control guidelines related to COVID-19 and its specific items.
- Further nursing studies should be performed to investigate the factors hindering and overcoming barriers that negatively affect the application of COVID-19 guidelines in different healthcare settings.

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