

Risk Factors among Health Care Workers Suffering from Corona Virus- 19 in Beni Suef Hospitals in Egypt

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Abstract

Background: The COVID-19 pandemic has resulted in day-to-day significant existential stress associated with the loss of many patients, colleagues, or loved ones. Health Care Workers (HCWs) are the frontline defense in our war against COVID-19 and a high risk of infection. **Aim:** to assess risk factors among health care workers suffering from corona virus-19 in Beni Suef hospital in Egypt. **Design:** A descriptive exploratory research design was used in the current study. **Setting:** This study was conducted in all units in Beni Suef hospitals in Egypt. **Sample:** A convenient sample of 107 healthcare workers (8 physicians, 14 registered nurses, 70 technical nurses, 2 radiologists , 1 physical therapist, 1 medical engineer devices 1, 2 pharmacists, 4 laboratory personnel, 2 cleaners and 3 others) who were previously affected by COVID-19. **Tools:** An interviewing questionnaire was used for data collection, which included seven parts. **Results:** Regarding factors affecting HCWs who were diagnosed with COVID-19, 97.20% were present when any aerosol-generating procedures which performed on the patient, 85.05% had direct contact with the environment where the confirmed COVID-19 patient was cared for, e.g. bed, linen, and 80.37% had face-to-face contact (within 1 meter) with a confirmed COVID-19 patient in a health care facility, while 78.50% were providing direct care to a confirmed COVID-19 patient in a health care facility, and 67.29% had interactions with multiple COVID-19 patients in health care facilities. **Conclusion:** Regarding factors affecting HCWs who were diagnosed with COVID-19, most of them were present when any aerosol-generating procedures were performed on the patient, had direct contact with the environment where the confirmed COVID-19 patient was cared for, e.g. bed, linen, had face-to-face contact (within 1 meter) with a confirmed COVID-19 patient in a health care facility, providing direct care to a confirmed COVID-19 patient, and had interactions with multiple COVID-19 patients in a health care facility. HCW are exposed to the hazards that put them in danger of infection. Hazards include exposure to patients with high viral load, long working hours, Psychological distress and dilemmas ,burnout from fatigue, stigma, and physical violence. **Recommendations:** Provide job- or task-specific education and training on preventing transmission of infectious agents. Expanding protective measures as digitalized or telemedicine services could potentially reduce patient contact and thus risks for infection.

Key words: Corona Virus- 19, Health Care Workers, Risk Factors

Introduction

The newly discovered coronavirus (COVID-19) was found in December 2019, which emerged in Wuhan, China, and has infected millions of people worldwide. Coronavirus is a communicable disease derived from a large family of viruses that cause the illness. It is similar to Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV), with typical symptoms such as fever, shortness of breath, cough, and acute respiratory failure. It is

also complicated by the fact that patients may present with atypical symptoms. This means COVID-19 has clinical presentations ranging from asymptomatic to acute respiratory distress syndrome and multiple-organ failure that lead to death (Al-Dossary, 2020).

Health Care Workers (HCWs) are the frontline defense in our war against COVID-19. Despite the high knowledge score and the positive attitudes that were observed, the number of infected and deceased Egyptian doctors and allied

health workers was high when compared to the general population, as reported by the Egyptian government official reports. So, providing HCWs, especially physicians, with mental, psychological, financial, and administrative support is crucial. For less educated HCWs and the general public, Continuous provision of PPE and training of all HCWs on proper infection prevention measures are serious and substantial (Wahed, 2020).

Diabetes and congestive heart failure are associated with an increased risk of mechanical ventilation and death, as is having more than two comorbidities. Dementia is a risk factor for hospitalization and death in COVID-19 patients, therefore warranting increased monitoring of this patient population. Former smokers are less likely than current smokers to be hospitalized (Van Gerwen, 2021).

A higher incidence rate of COVID-19 in men might be due to higher social interactions in work places. The incidence of underlying diseases such as hypertension and subsequent hospitalization in the invasive care unit and death has been reported in HCW with COVID-19. Chronic diseases such as hypertension, respiratory system disease, cardiovascular disease, and their susceptibility conditions may be associated with the pathogenesis of COVID-19. Chronic diseases participate in some standard characteristics with infectious disorders, such as the pro-inflammatory state and the attenuation of the natural immune response. Additionally, metabolic diseases may lead to weak immune function by weakening macrophage and lymphocyte function, which may make individuals more susceptible to disease complications (Shahbazi, 2020).

COVID-19 can not only be transmitted through the inhalation of droplets and aerosols, but it can also be spread by direct or indirect contact with the oral mucosa, nasal cavity, and eye mucous. Direct transmission is defined as directly touching the saliva, excrement, and other pollutants of confirmed COVID-19 patients. Healthcare workers are a high-risk profession for COVID-19 due to their direct contact with the oral cavity containing saliva. This saliva can directly land on the eye mucosa

or nasal cavity if the health worker does not wear eye protection or a mouth-nose cover mask, and the indirect transmission of SARS-CoV-2 means that this virus can persist in the environment. The virus can remain in the fomites after the droplets/aerosol/splatter fall (Arinawati, 2021)

Significance of the study

The COVID-19 pandemic has resulted in day-to-day significant existential stress associated with the loss of many patients, colleagues, or loved ones (WHO, 2020). In addition to health-related problems, the pandemic has also created financial problems and fears of an imminent economic crisis and depression. Due to the pandemic, many workplaces, including factories, schools, and universities, have closed down. Preventive measures such as self-isolation, travel restrictions, and lockdown have forced a decrease in the workforce across all economic sectors, and the need for medical products has significantly increased (Morgul et al., 2020) The health care system in Egypt requires creative as well as practicable solutions to develop and upgrade its current and future challenges, in that teamwork and collaboration are the essence of emergency care.

Aim of the study

This study was aimed to:-

Assess risk factors among health care workers suffering from corona virus-19.

Research Question:

This study was conducted for answering this question: 1-What are the risk factors among healthcare workers suffering from the coronavirus-19?

Research design:

A descriptive exploratory research design was used to fulfill the aim of the study.

Setting:

The study was conducted at all units in Beni-Suief hospitals in Egypt, which composed of seven floors including units (surgical, medical, intensive care, cardiac care, neurology,

operating unit, neonate unit, obstetric unit and administration unit) .

Subjects:

A convenient sample of all available health care workers whom previously affected with covid-19 including (107) health care workers recruited from previously mentioned setting and classification as the following:- (physicians (8), Registered nurses (14) , Technical nurse (70), Radiologist (2) , Physical therapist (1), Medical Devices Engineer (1) , Pharmacists (2) , Laboratory personnel (4), Cleaners(2) , and Account administrator (3)).

Tools for data collection:

The data was collected by using the following tool:

The healthcare workers' interviewing questionnaire is adapted from (**Risk assessment and Management of exposure of health care workers in the context of covid-19**) designed by (**WHO, 2020**) to determine the risk categorization of each HCW after exposure to a Covid-19 patient and it is composed of 5 Parts as following:-

Part I : composed of 3 sections:-

Sections 1: It concerned demographic characteristics of HCWs such as age, gender, experience, qualifications, and type of health care personnel.

Sections 2: It is concerned with HCWs medical history. It is composed of four questions to assess current and past medical history which includes: A history of staying in the same environment with a confirmed COVID-19 patient, a history of travelling together with a confirmed COVID-19 patient, a history of Chronic disease and type and smoking.

Section 3: It is concerned with health history status characteristics which include symptoms of disease.

Part II: It is concerned with HCWs activities performed on COVID-19 patients in health care facilities. It is composed of (6) closed-ended questions that include (Did you provide direct care to a confirmed COVID-19 patient?, Did you have face-to-face contact with a confirmed COVID-19 patient in a health care facility?, Were you present when any aerosol-generating procedures were performed on the patient?, Did you have direct contact with the environment where the confirmed COVID-19 patient was cared for? Were you involved in health care interaction(s) (paid or unpaid) in another health care facility during the period above?_Interaction with multiple COVID-19 patients in a health care facility?).

Part III: It concerned with activity of infection prevention and control readiness activity scale (CDC and WHO , 2020), it is composed of (29) questions with Yes or No to assess Health care workers adherence to Infection prevention and control readiness activity .

❖ Scoring system:

It is scored by 0 for NO answer and 1 for Yes answer . HCW are classified as: > 90 % (26 question)considered as adequate, <90% (3) considered as non- adequate.

Part IV: It concerned with infection prevention and control {IPC} procedures during health care interactions scale. It is composed of (7) closed-ended questions consisting of 10 items with rating responses (Always, Most of the time, Occasionally, Rarely) that include Did you wear personal protective equipment (PPE)? Did you remove and replace your PPE according to protocol? , Did you perform hand hygiene before and after touching the COVID-19 patient? Did you perform hand hygiene before and after any clean or aseptic procedure? Did you perform hand hygiene after exposure to body fluid? ,Did you perform hand hygiene after touching the patient's surroundings? , Were high- touch surfaces decontaminated frequently?).

❖ Scoring system:

It is scored by (Always (4), Most of the time (3), Occasionally (2), Rarely (1)). The total score for this scale was 40, which constitutes 100%.

HCWs are classified as: > 90% (25 questions) considered as adherent, <90% considered non-adherent.

Part V: It is concerned with infection prevention and control (IPC) measures when performing aerosol-generating procedures scale. It is composed of six closed-ended questions consisting of 10 items with rating responses (Always, Most of the time, Occasionally, Rarely) that include (Did you wear personal protective equipment (PPE)? Did you remove and replace your PPE according to protocol? Did you perform hand hygiene before and after touching the COVID-19 patient? Did you perform hand hygiene before and after any clean or aseptic procedure? Did you perform hand hygiene after touching the patient's surroundings? Were high-touch surfaces decontaminated frequently?).

❖ Scoring system: -

It is scored by (Always(4),Most of time(3),Occasionally(2),Rarely(1)). The total score for this scale was 40, which constitutes 100%.

HCW are classified as: > 90% (21 questions) considered as adherent, <90% considered non-adherent.

II . Operational Design:

The operational design includes a preparatory phase, testing validity, tools reliability, pilot study and field work.

The preparatory phase:

It included a review of past, current, national, and international related literature and theoretical knowledge of various aspects of the study using books, articles, internet periodicals, and magazines.

Tool validity:

The tool was revised by a panel of 13 experts from the Medical Surgical Nursing department, Faculty of Nursing, Ain Shams University (4 professors and 9 assistant professors) to review the tool for clarity, accuracy, relevance, comprehensiveness, understanding, applicability, scoring and recording. Modification of the tool was done according to the panels' judgment.

(2)-Reliability:

It was analyzed by measuring the internal consistency of the tool through Cronbach's alpha test. The Cronbach's alpha model, which is a model of internal consistency, was used in the analysis of HCW's interviewing questionnaire and was reliable at (0,744).

Ethical Considerations:

Prior to conducting the pilot study, ethical approval was obtained from the scientific research ethical committee of the Faculty of Nursing at Ain Shams University. In addition, written informed consent was obtained from each participant prior to data collection. They were assured that anonymity and confidentiality would be guaranteed, and they had the right to withdraw from the study at any time without giving any reason. Ethics, values, culture, and beliefs were respected.

Pilot Study:

It was carried out on 10% (N = 12) of HCWs diagnosed with COVID-19 to test the applicability and clarity of the tool as well as to estimate the time needed to fill it in. Necessary modifications were made to the tool, and HCWs included in the pilot study were excluded from the sample.

Field Work

The aim of the study and components of the tools were explained to health workers at the beginning of data collection . Data collection took about 8 months, from January 2021 until the end of August 2021. Data was collected twice a week, in the morning and afternoon shifts, in the aforementioned setting

affiliated with Beni-Suef General Hospital. They were assured that the information collected would be treated confidentially and would be used only for the purpose of the study (oral and written consent were taken from health workers). The investigator managed to interview 3 to 5 HCW daily. Time taken to fill study tools ranged from 30–45 minutes on an individual basis to be filled depending on the degree of understanding and response of the HCW.

III . Administrative Design:

An official letter was obtained from the Dean of the Faculty of Nursing at Ain Shams University to obtain approval to carry out the study and interview the health care workers in the selected governmental hospital. Approval to carry out this study was obtained from the director of Beni Suef general hospital , and the nursing director.

IV. Statistical design:

The collected data were organized , categorized, tabulated, & analyzed using Excel program to evaluate HCWs under study. The statistical analysis included percentage (%), mean, standard deviation (SD), and Graphs were created for data visualization using Microsoft Excel. A P value of ≤ 0.05 indicates a significant result, while a P value of > 0.05 indicates a non-significant result.

Results:

Table (1): illustrates that, 29.91% of HCWs age ranged between 20-<30 years with a mean age of 37.26 ± 9.74 , 84.11% of the studied HCWs were females, 52.34% of the studied HCWs had >15years of experience 57.00% of the studied HCWs had diploma of nursing and 65.42% of the studied HCW were nurse technicians, and only 8% the studied health care workers were medical doctors.

Table (2): illustrates that , 24.30 of HCWs had a history of staying in the same environment with a confirmed COVID-19 patient, and 27.10% of HCWs were suffering from chronic disease, such as HTN, DM ,Immune disease, chest allergy with

percentage of 7.48 % , 4.67% ,5.61%, 5.61% respectively.

Table (3): illustrates that , 94.39% of HCWs suffered from fatigue, 91.59% of them suffered from body aches, 74.77% of them suffered from cough, while 5.61% of them suffered from change of mental status during the previous COVID-19 infection.

Figure(1): illustrates that 46% of HCWs had mild grade of disease and 34% of studied subjects had moderate grade of disease while 20 % of them had the severe grade of disease.

Table (4): illustrates that 78.50% of HCWs provided direct care to a confirmed COVID-19 patient, 80.37% of HCWs had the face-to-face contact (within 1 meter) with a confirmed COVID-19 patient in a health care facility , 97.20% were present when any aerosol-generating procedures were performed on the patient, 90.65% of HCWs Present during nebulizer treatment procedures were performed on the patient, while 85.05% of HCWs had direct contact with the environment where the confirmed COVID-19 patient was cared for e.g. bed, linen and 67.29% of HCWs had interactions with multiple COVID-19 patients in health care facility.

Figure (2): illustrates that 76% of HCWs are adherent to infection prevention and control readiness activity and 24% of studied subjects are non-adherent to infection prevention and control readiness activity.

Table (5): reveals that, 86.92% of HCWs were always wear medical mask, 79.44% of them always Perform hand hygiene after exposure to body fluid , 49.53% of them always remove and replace PPE according to protocol and 43.93% of them always Wear face shield or goggles/protective glasses While, 41.12% of them always wear disposable gown.

Figure (3): illustrates that 50% of HCWs are adherent to infection prevention and control during health care interaction and 50% of studied subjects are non-adherent to infection

prevention and control during health care interaction.

Table (6): shows that, 85.05% of HCWs were always wear single-use gloves, 76.64% of them always were adherent to perform hand hygiene before and after touching the COVID-19 patient , perform hand hygiene before and after any clean or aseptic procedure was performed, perform hand hygiene after touching the patient's surroundings, 50.47% of them always were wear N95 mask, 48.60% of them always were wear face shield or goggles/protective glasses, 44.86% of them always were wear disposable gown and 43.93% of them always wear waterproof apron.

Figure (4): interpreted that 42% of HCWs are adherent to infection prevention and control measures when performing aerosol-generating procedures and 58% of them are non-adherent to infection prevention and control measures

Table (1): Frequency and percentage distributions of demographic characteristics of the studied subjects (n=107).

Health worker information	Frequency	Percent
Age		
20-<30	32	29.91%
30-<40	31	28.97%
40-<50	31	28.97%
>50	13	12.15%
Mean ± SD	37.26 ± 9.74	
Gender :- Male	17	15.89%
Female	90	84.11%
Experience :-		
1-<5	19	17.76%
5- <10	20	18.69%
10-<15	12	11.21%
>15	56	52.34%
Qualifications :-		
Diploma	61	57.01%
Technical	20	18.70%
Bachelor	26	24.30%
post graduate	0	0.00%
Type of health care personnel:-		
Medical doctor	8	7.47%
Registered nurse (or equivalent)	14	13.09%
Technician nurse (or equivalent)	70	65.43%
Radiology /X-ray technician	2	1.88%
Physical therapist	1	0.93%
Engineer Medical Devices	1	0.93%
Pharmacist	2	1.88%
Laboratory personnel	4	3.73%
Cleaner	2	1.88%
Others(Accounts Administrators)	3	2.81%

when performing aerosol-generating procedures .

Table (7): illustrates that there is a positive correlation of moderate strength and statistically highly significant between adherence to IPC procedures during health care interactions scale and adherence to IPC measures when performing aerosol-generating procedures scale.

Table (8): shows the mean values of the infection prevention and control readiness activity scale are high for all grades and the difference is statistically non-significant at $P > .05$, The mean values of the Adherence to IPC procedures during health care interactions scale are decreasing with increasing the grades from mild to severe and the difference is statistically significant at $P < .05$ and The mean values of Adherence to IPC measures when performing aerosol-generating procedures scale are decreasing with increasing the grades from mild to severe and the difference is statistically non-significant at $P > .05$.

Table (2): Frequency and percentage distributions of health history characteristics and smoking among studied subjects (n = 107).

Items	NO		Yes	
	Frequency	%	Frequency	%
A history of staying in the same environment with a confirmed COVID-19 patient	81	75.70	26	24.30
A history of traveling together in close proximity (within 1 meter) with a confirmed COVID- 19 patient in any kind of conveyance	99	92.52	8	7.48
Smoking	100	93.46	7	6.54
Passive smoker	7	6.54	100	93.46
A history of Chronic disease	78	72.90	29	27.10
Type of Chronic disease:-				
HTN	99	92.5	8	7.48
DM	102	95.3	5	4.67
Immune disease	101	94.3	6	5.61
Cardiac disease	105	98.1	2	1.87
Chest allergy	101	94.3	6	5.61
Others anemia, cancer	105	98.1	2	1.87

Table (3):Frequency and percentage distributions of clinical data among studied subjects (n=107).

Symptoms	Frequency	%
Fever or chill	59	55.14
Cough	80	74.77
Body aches	98	91.59
Diarrhea	28	26.17
Nausea or Vomiting	10	9.35
Loss of smell	32	29.91
Loss of taste	37	34.58
Fatigue	101	94.39
Headache	97	90.65
Runny nose Or sore throat	74	69.16
Pain in the chest	25	23.36
Difficult of breathing	32	29.91
Colored skin or lips	8	7.48
Change of mental status	6	5.61
Loss of appetite	74	69.16
Low blood oxygen level	16	14.95

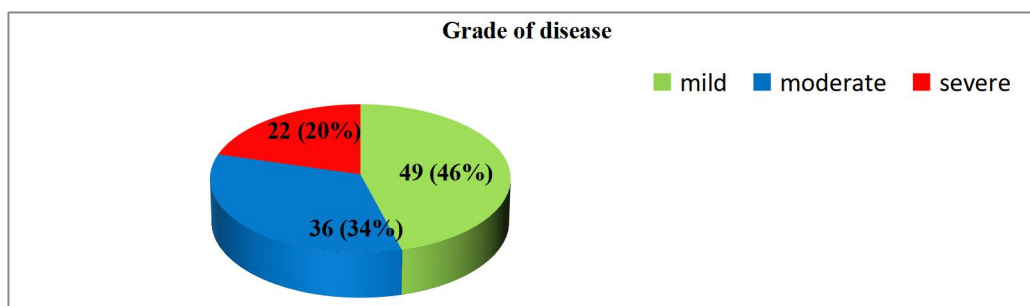
**Figure (1):** Frequency and percentage distributions of grade of disease among studied subjects (n=107).

Table (4): shows the frequency and percentage distributions of HCW activities carried out on COVID-19 patients in a health care facility (N = 107).

Items	NO		Yes	
	Frequency	%	Frequency	%
Providing direct care to a confirmed COVID-19 patient	23	21.50	84	78.50
The face-to-face contact (within 1 meter) with a confirmed COVID-19 patient in a health care facility	21	19.63	86	80.37
Present when any aerosol-generating procedures were performed on the patient.	3	2.80	104	97.20
Type of the procedure				
• Tracheal intubation	59	55.14	48	44.86
• Nebulizer treatment	10	9.34	97	90.65
• Open airway suctioning	56	52.33	51	47.66
• Collection of sputum	100	93.4	7	6.54
• Tracheotomy	105	98.13	2	1.87
• Bronchoscopy	106	99.06	1	0.93
• Cardiopulmonary resuscitation	60	56.07	47	43.93
• Other	93	86.91	14	47.66
Direct contact with the environment where the confirmed COVID-19 patient was cared for e.g. bed, linen	16	14.95	91	85.05
Health care interaction(s) (paid or unpaid) in another health care facility.	96	89.72	11	10.28
The another health care interaction				
• Health care facility (public or private)	103	96.26	4	3.74
• Ambulance	107	100	0	0
• Home care	99	92.52	8	7.48
• Other	102	95.32	5	4.67
Interactions with multiple COVID-19 patients in health care facility	35	32.71	72	67.29

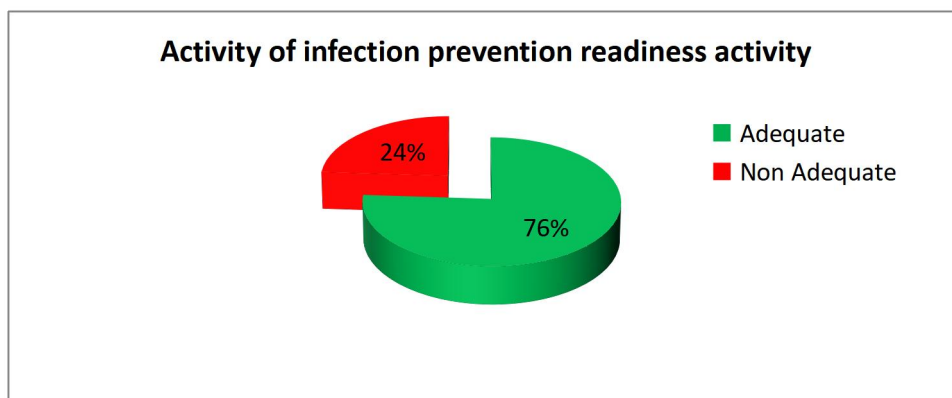
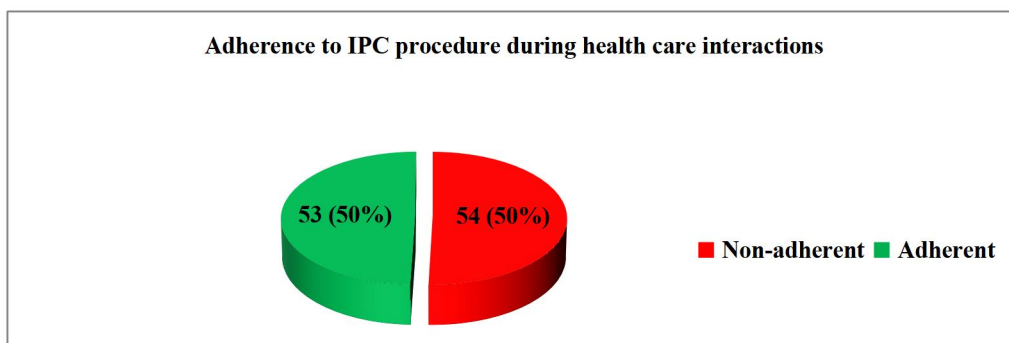


Figure (2) : Frequency and percentage distributions of activity of infection prevention and control readiness activity among the studied subjects (n=107) .

Table (5): Adherence to infection prevention and control procedure when performing health care interactions with Covid-19 confirmed patient among studied subjects (N =107) .

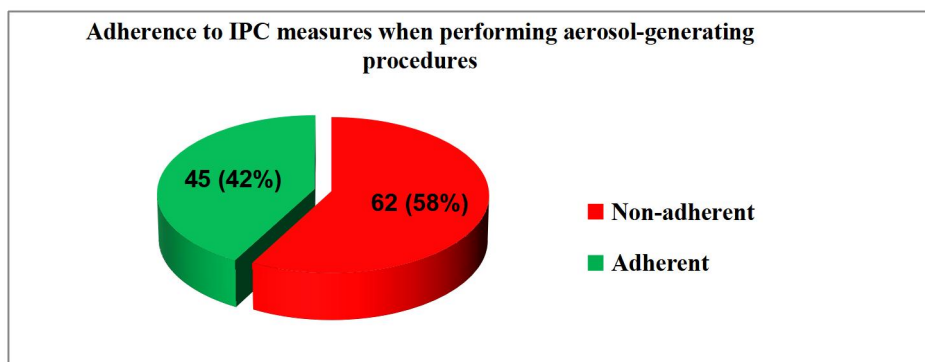
Infection prevention and control procedures	Rarely		Occasionally		Most of the time		Always, as recommended	
	Frequency	%	Freq.	%	Frequency	%	Frequency	%
• Wear single-use gloves	12	11.21	1	0.94	11	10.28	83	77.57
• Wear medical mask	6	5.61	2	1.86	6	5.61	93	86.92
• Wear face shield or goggles/protective glasses	22	20.56	22	20.56	16	14.95	47	43.93
• Wear disposable gown	25	23.36	23	21.50	15	14.02	44	41.12
Remove and replace PPE according to protocol	21	19.63	13	12.15	20	18.69	53	49.53
Perform hand hygiene before and after touching the COVID-19 patient	12	11.21	6	5.61	8	7.48	81	75.70
Perform hand hygiene before and after any clean or aseptic procedure was performed	12	11.21	8	7.48	4	3.74	83	77.57
Perform hand hygiene after exposure to body fluid	11	10.28	7	6.54	4	3.74	85	79.44
Perform hand hygiene after touching the patient's surroundings	12	11.21	7	6.54	8	7.48	80	74.77
Decontaminated high-touch surfaces frequently	10	9.35	12	11.21	6	5.61	79	73.83



Figure(3): Frequency and percentage distributions of Adherence to infection prevention and control during health care interaction among the studied subjects (n=107) .

Table (6): Adherence to infection prevention and control measures when performing aerosol-generating procedures among studied subjects (n=107).

Infection prevention and control measures when performing aerosol-generating	Rarely		Occasionally		Most of the time		Always, as recommended	
	Freq	%	Freq	%	Freq	%	Frequency	%
• Wear single-use gloves	9	8.41	4	3.74	3	2.80	91	85.05
• Wear N95 mask (or equivalent respirator)	33	30.84	13	12.15	7	6.54	54	50.47
• Wear face shield or goggle-s/protective glasses	19	17.75	27	25.23	9	8.41	52	48.60
• Wear disposable gown	18	16.82	26	24.30	15	14.02	48	44.86
• Wear waterproof apron	22	20.56	24	22.43	14	13.08	47	43.93
Remove and replace PPE according to protocol	19	17.75	10	9.35	22	20.56	56	52.34
Perform hand hygiene before and after touching the COVID-19 patient	13	12.15	4	3.74	8	7.48	82	76.64
Perform hand hygiene before and after any clean or aseptic procedure was performed	12	11.21	4	3.74	9	8.41	82	76.64
Perform hand hygiene after touching the patient's surroundings	11	10.28	7	6.54	7	6.54	82	76.64
Decontaminated high-touch surfaces frequently	15	14.02	10	9.35	5	4.67	77	71.96



Figure(4):Frequency and percentage distributions of Adherence to infection prevention and control measures when performing aerosol-generating procedures among the studied subjects (n=107) .

Table (7): Correlation between adherence to infection prevention and control procedures during health care interactions scale and adherence to IPC measures when performing aerosol-generating procedures scale.

Items	Items	Coefficient	P Value
Pearson Correlation	Adherence to IPC procedures during health care interactions scale Adherence to IPC measures when performing aerosol-generating procedures scale	.752	0 P <.001 **

Table (8) : Relation of the disease grade with the three main scales among the studied subjects.

Items	Disease Grade	N	Mean	SD	F	P Value
Infection prevention and control readiness activity scale	Mild	49	89.44	14.31	1.81	0.16833 P >.05
	Moderate	36	92.53	11.90		
	Severe	22	95.14	5.06		
Adherence to IPC procedures during health care interactions scale	Mild	49	82.65	19.99	3.54	0.03251 P <.05 *
	Moderate	36	77.41	26.17		
	Severe	22	65.15	34.62		
Adherence to IPC measures when performing aerosol-generating procedures scale	Mild	49	76.19	25.91	1.17	0.31509 P >.05
	Moderate	36	73.06	28.50		
	Severe	22	65.00	33.91		

R: Pearson's correlation coefficient (**) statistically significant at p<0.01

Discussion:

Concerning demographic characteristics of health care workers, the results of the present study revealed that, more than one quarter of the studied health care workers age ranged between 20-<30 years and

the majority of them were females. This finding was agreed with the result of (*Atnafie, et al., 2021*) who revealed two thirds of studied health care worker age ranged between 25-34 years. Also, this result disagree with the result of (*Alraddadi, et al., 2016*) who founded that more than half of studied health care workers age ranged between 29-59 years and were females.

This might be due to that most of those who enroll in nursing are females.

Regarding experience and qualifications, the current study showed that, slightly more than half of studied health care workers had >15years of experience and had diploma of nursing. This study was in agreement with *the result of (Shahil, et al., 2021)* who mentioned that more than one third of studied health care workers had >15years of experience. Contrariwise, this study was in disagreement with the result of *(Elbqry, et al., 2021)* who revealed that two third of studied health care workers had 6-10 years of experience and had bachelor. This may be related to studied health care workers' age, two thirds of them their age more than 30 years.

Concerning type of health care personnel, the present study illustrated that, two third of studied health care workers were nurse technicians and a minority of them were medical doctors. This finding was congruence with the result of *(Zhang, et al., 2020)* who founded nearly one half of the study respondents were nurses. Conversely, this study was in disagreement with *the result of (Al Ghafri, et al., 2020)* who revealed that more than half of studied health care workers were doctors. This might be due ratio of nurses to patient is more than ratio of doctors to patients.

Related to health history characteristics, the current study revealed that, one quarter of studied health care workers had a history of staying in the same environment with a confirmed COVID-19 patient. This result disagreed with the result of *(Albaqawi, et al., 2021)* who mentioned that the study participants were reported to have a history of staying in the same household with each other with a confirmed Covid-19 patient. This finding was supported by the results of *(Oda, et al., 2020)* who mentioned that one third of studied healthcare workers were working in hospitals with more than 15% inpatient COVID-19 test positivity. Also, this result was agreed with the result of *(Wei, et al., 2020)* who found that healthcare workers working in county-level hospitals in high-risk areas were more vulnerable to COVID-19. HCW working

in general, ophthalmology, and respiratory departments were prone to deterioration compared with HCW working in the infection department.

The present study showed that, one quarter of studied health care workers were suffering from chronic diseases such as HTN, DM, immune disease, and chest allergy. This result was agreed with the result of a study *(Kishk, et al., 2021)* that was titled Assessment of potential risk factors for coronavirus disease-19 (COVID-19) among health care workers, which mentioned that slightly less than one quarter of the studied health care workers were suffering from DM, heart diseases, and other chronic lung diseases. This study is supported by the result of *(Chudasama, et al., 2020)* study entitled Impact of COVID-19 on routine care for chronic diseases: A global survey of views from healthcare professionals, which showed that nearly one third of studied healthcare workers were suffering from chronic diseases such as HTN and DM. This could be related to the fact that more than one third of them are older than 40 years.

Concerning symptoms of COVID-19, the current study showed that, a majority of studied health care workers suffered from fatigue and a minority of studied health care workers suffered from change of mental status. This study was supported by *the result of a study (Van Loon, et al., 2020)* that was titled "Diagnosis of COVID-19 Based on Symptomatic Analysis of Hospital Healthcare Workers in Belgium: Observational Study in a Large Belgian Tertiary Care Center During Early COVID-19 Outbreak" which found two thirds of studied health care workers suffered from fatigue. This study was in disagreement with *the result of (Hunter, et al., 2016)* study that was titled Transmission of Middle East Respiratory Syndrome Coronavirus Infections in Healthcare Settings, Abu Dhabi, which revealed that less than one quarter of studied healthcare workers suffered from fatigue/malaise.

Regarding grade of the disease, the constant study showed that, more than one third of studied health care workers were had mild

grade of covid-19 and less than one quarter of them were had sever grade of covid-19. This result was agreed with *the result of (El-Raey, et al., 2021)* study that is titled *Predictors for Severity of SARS-CoV-2 Infection Among Healthcare Workers* who revealed that slightly less than one third of studied health care workers were had mild disease of Covid-19 (30.4%), near half had moderate disease(48.5%), less than one quarter had severe disease(17.2%)and the lowest percentage had critical disease(3.9%) . Also, this finding was supported by *the result of (Navarro-Font, et al., 2021)* study. This might be related to that their age, a minority of them more than 50 years and COVID-19 grades become worse with age.

Concerning health care worker activities performed on COVID-19 patients in a health care facility. The current study reported that two thirds of studied healthcare workers had direct care of a confirmed COVID-19 patient. This finding was in disagreement with *the result of the (Heinzerling, et al., 2020)* study entitled *Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient Solano County, California, February 2020*, which revealed that the third staff member reported close contact with the patient for a total of 2 hours but not during aerosol-generating procedures. This study is in disagreement with *the result of (Atnafi, et al., 2021)* who mentioned that more than half of the studied healthcare workers didn't have face-to-face contact with a confirmed COVID-19 patient. This related to the spread of COVID-19 in the country, and the majority of studied healthcare workers were nurses and doctors who provide direct care for patients.

The present study revealed that , a majority of studied healthcare workers were present when any aerosol-generating procedures were performed on the patient. This finding is in agreement with the result of **(Woon, et al., 2020)** who found that the majority of health care workers were involved in aerosol generating procedures and contact with infected patients' body fluids. This might be due to the fact that a majority of studied subjects were doctors and nurses who provide direct care for patients.

The current study showed that, a majority of studied health care workers were present during nebulizer treatment and a minority of them had interactions in another health care facility. This findings was disagreement with the result of **(Heinzerling, et al., 2020)** who them presented that nearly half of studied health care workers were presented for or assisting with nebulizer treatments was more common among HCW who developed COVID-19. This finding was disagreed with by the results of **(Delgado, et al., 2020)** who mentioned that more than one third of studied health care workers worked in both hospital-based and private practice. This could be related to the fact that two thirds of them were technicians and may have worked in many private hospitals.

Regarding activity of infection prevention and control readiness activity, the present study showed that, more than three quarters of studied health care workers were had adequate to infection prevention and control readiness activity and less than one quarter of them are non- adequate to infection prevention and control readiness activity. This result was agreed with the result of **(Do, et al., 2020)** who stated that HCWs had better adherence to IPC procedures, had a higher likelihood of healthy eating , were more physically active and had a lower likelihood of suspected COVID-19 symptoms. This might related to the training from infection control committee.

Regarding adherence to infection prevention and control procedures during health care interactions, the constant study revealed that, more than two third of studied health care workers were always as recommended wear medical mask. This result was supported by the result of **(Li, et al., 2021)** who mentioned that slightly more than half of studied health care workers wear medical mask when performing non aerosolizing, routine patient care and any other procedure. Also, this result was in agreement with the result of **(Picard, et al., 2020)** who revealed that more than two third of studied health care workers were represented wearing mask. this reflect their adherence to infection control.

The present study showed that, more than one third of studied health care workers always as recommended wear disposable gown,

This result was agreed with the result of (Lee, et al., 2021) study that is titled Assessing personal protective equipment needs for healthcare workers who reported that about one third of health care workers wear disposable apron. This study was agreed with the result of (Delgado, et al., 2020) study. this may be related to shortage in medical supplies during COVID 19 epidemic.

The present study showed that, half of studied health care workers were had adherent to infection prevention and control procedures during health care interactions and other half are non-adherent. This result was disagreed with the result of (Ashinyo, et al., 2021) who stated that the majority of the HCWs indicated that they have never experienced an interruption in water supply in the treatment centers, that PPEs were sufficient and a significant proportion of the healthcare workers have received training on IPC. This might related to that some of them had not implementation infection prevention and control instructions as ideal.

Concerning adherence to infection prevention and control measures when performing aerosol-generating procedures, the current study revealed that, more than two third of studied health care workers were always as recommended wear single-use gloves and more than one third of them always as recommended wear waterproof apron, This result was supported by the result of (Powell-Jackson, et al., 2020) who founded that more than two third of studied health care workers were wear single-use gloves. Contrariwise, this finding was disagreed with the result of (Kotian, et al., 2020) study that is titled *A web survey to assess the use efficacy of personnel protective materials among allied health care workers during COVID-19 pandemic at North-East India* who founded that more one third of studied health care workers don't use the PPE. which related to their adherence to infection control strategy as recommended.

The constant study revealed that, a majority of studied health care workers were always as recommended wear single-use gloves during aerosol-generating procedures, This finding was agreed with *the result of*

(Ashinyo, et al., 2021) who mentioned that, a majority of studied health care workers were always wear single-use gloves. Contrariwise, this result was disagreed with the result of (Belova, et al., 2022) who reported that more than one third of studied health care workers wear disposable gloves. this could be reflect their awareness to preventive measures.

The present study showed that, more than one third of studied health care workers were always as recommended wear waterproof apron, This result was disagree with the result of (Lee, et al., 2021) who mentioned that less than one quarter of studied health care workers were wear reusable apron because complaint that PPE is very heavy on their bodies. Also, this study supported by the result of (Tabah, et al., 2020) study that is titled *Personal protective equipment and intensive care unit healthcare worker safety in the COVID-19 era (PPE-SAFE): An international survey* who showed that two third of studied health care workers were wear water proff long sleeve gowns. this might be reflect their awareness by that the covid can transport through clothes.

The present study showed that, more than two fifth of studied health care workers were had adherent to infection prevention and control measures when performing aerosol-generating procedures and more than half of are non-adherent. This result was agreed with the result of (Tran, et al., 2012) who stated that *Risk of SARS Transmission to HCWs Exposed and Not Exposed to Aerosol-Generating Procedures. Aerosol Generating Procedures as Risk Factors for SARS Transmission*. This might be due to that they had not adequate PPE at some times.

Regarding correlation between adherence to infection prevention and control procedures during health care interactions scale and adherence to infection prevention and control measures when performing aerosol-generating procedures scale, the present study showed that, there was positive correlation between adherence to infection prevention and control procedures during health care interactions scale and adherence to infection prevention and control

measures when performing aerosol-generating procedures scale. This study in agreement with the result of (Alraddadi, et al., 2016) who revealed that there was a relation between health care workers always covering their nose and mouth with a medical mask or N95 respirator when caring for COVID-19 patients and protection against infection among health care workers participating in aerosol-generating procedures. Also, this finding was agreed with the result of (Palmore, et al., 2022) who revealed that Limiting movement outside the patient's room, prioritizing the use of certain PPE for the highest risk situations (eg, aerosol-generating procedures), and designating entire units within a facility to care for known or suspected patients with COVID-19. The CDC suggests using a respirator rather than a medical mask when caring for all patients with suspected or confirmed COVID-19. However, when supplies are limited, respirators should be prioritized for aerosol-generating procedures.

About the relation between the disease grade and the three main scales. The present study showed that, there was a statistically significant relation between the disease grade and adherence to infection prevention and control procedures during health care interactions scale, This result was supported by the result of (Kim, et al., 2021) who revealed that less access to PPE was strongly associated with both increased risk of reporting Covid-19 illness as well as more prolonged and severe disease course in frontline HCWs. Also, this result was disagreed with the result of (Schmitz, et al., 2020) who mentioned that the use of high-level PPE (ffp2 or equivalent and eye protection) by HCW during all contacts with patients with suspected or confirmed SARS-COVID-2 does not seem to be associated with a lower infection rate of HCW compared to lower level PPE use. This may be due to that adherence of infection prevention and control procedures may reduce severity of infection.

The present study revealed that, there was no statistically significant relation between the disease grade, infection prevention and control readiness activity scale and adherence to infection prevention and control measures when performing aerosol-generating procedures scale.

This study was disagreed with the result of (El-Sokkary, et al., 2021) who mentioned that there was statistically significant relation between compliance of health care workers to proper use of personal protective equipment and performing procedures that pose health care workers at a high risk of exposure to severe acute respiratory syndrome coronavirus. Also, this finding was disagreed with the result of (Bhargava, et al., 2021) who revealed that there was a statistically significant relation between COVID occurrence and availability of personal protective equipment at hospital and health care system equipped for pandemic.

Conclusion:

Regarding factors affecting HCW who were diagnosed with COVID-19, most of them were present when any aerosol-generating procedures were performed on the patient, had direct contact with the environment where the confirmed COVID-19 patient was cared for, e.g. bed, linen, had face-to-face contact (within 1 meter) with a confirmed COVID-19 patient in a health care facility, providing direct care to a confirmed COVID-19 patient, and had interactions with multiple COVID-19 patients in a health care facility. HCW are exposed to the hazards that put them in danger of infection. Hazards include exposure to patients with high viral load, long working hours, Psychological distress and dilemmas, burnout from fatigue, stigma, and physical violence.

Recommendations:

The results of this study projected the following recommendations:-

- Provide job- or task-specific education and training on preventing transmission of infectious agents associated with healthcare during orientation to the healthcare workers.
- Update information periodically during ongoing education programs about standard precautions.
- Expanding protective measures as digitalized or telemedicine services could potentially reduce patient contact and thus risks for infection.
- Offering useful recommendations for government agencies such as isolating

infected cases in specific well-equipped hospitals.

- Expanding protective measures for HCW to decrease infection rates among family members and colleagues.
- Further research studies are needed to focus on assessment risk factors for HCWs who diagnosed with COVID-19.

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