

# Forward Action Plan for adherence to Infection Prevention And Control to Health Care Workers During Care For Suspected or Confirmed Covid-19 Patients

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## Abstract

**Background:** Healthcare workers are the frontline armies in the fight against the Corona virus disease-2019 (COVID-19) pandemic, and their safety should be an urgent focus in the global response to the pandemic. **The study aims** to suggest a forward action plan for adherence to infection prevention and control to health care workers during care for suspected or confirmed Covid-19 patients at Hospitals based on gaps, weaknesses, and barriers from health care workers (HCWs) perspective. **Design:** A cross-sectional study was used. **Tools:** A validated electronic self-assessment tool built-in Google drive and was distributed to HCWs who have been exposed to the patient(s) with suspected or confirmed COVID-19 in at different Cities (Zagazig city, Mansoura city, and Cairo city) in Egypt. Two tools were used 1) included three sections: personal and job characteristics of HCWs, the COVID-19 infection rate among HCWs, adherence of HCWs to infection prevention and control during health care, and 2) the barriers to applying preventive measures. EQUATOR research checklist (STROBE) were used by the researchers. **Results:** Around 439 HCWs participated in the study; 225 were males and 214 were females. (63.1%) of the respondents were nurses. (59.7%) of the respondents were contacted and 13.2% were infected and COVID-19 test results were positive. **Conclusions:** Strengths in adherence of HCWs regarding triage, early recognition, and source control, standard precaution for all patients, empiric additional precautions, wearing and removing protective equipment and administrative controls play important role in infection control. However, a number of gaps and weaknesses were revealed in applying preventive measures to control infection with COVID-19.

**Keywords:** infection controls, COVID-19 patients, nurses, health care workers.

## Introduction

Healthcare workers are one of the professionals who are affected severely by the Coronavirus Disease-2019 (COVID-19) pandemic and measures should be taken provide them with safe working conditions (Agalar and Engin, 2020). Additionally, health care workers are dealing with a huge influx of patients, while also facing a lack of equipment in many cases and the fear of becoming infected themselves. Often, they face heartbreaking decisions while treating their patients (Makri, 2021). In Italy, one of the worst affected countries, dozens of doctors and nurses have died from COVID-19 and thousands of healthcare workers have become infected (Alegbeleye, 2020). Global spread of COVID 19 included Egypt, and the first case

was recorded in Egypt on February 14, 2020. The total number of COVID 19 cases and mortality has been increasing since then. Confirmed cases among health care workers were 11% of the total confirmed cases (Zhao et al., 2020). Moreover, Egypt is one of the lower-middle-income countries with limited resources that require a simple and practical clinical guideline to diagnose and treat COVID-19 cases, as well as to protect health care workers (Ramadan et al., 2020). Therefore, infection prevention control (IPC) should be practiced to stop the spread of COVID 19 among health care workers in health care institutions and also in traditional practitioners (To et al., 2020). On the same line, IPC is a critical part of health system strengthening and must be a priority to protect patients and healthcare workers (Abate et al.,

2020). In addition, application of these precautions depends on the nature of the health worker personnel-patient interaction and the anticipated exposure to a known infectious agent. Standard precautions include: hand hygiene, personal protective equipment (PPE), and reparatory hygiene and cough etiquette, cleaning and disinfection of devices and environmental surfaces, safe injection practices, and medication storage and handling. Transmission based precautions are a set of practices specific for patients with known or suspected infectious agents that require additional control measures to prevent transmission (Islam et al., 2020).

### Significant of our study:

There are various reports on spread of COVID 19 among the healthcare workers of Egypt (Wahed et al., 2020). Also, first and foremost, protect those in the healthcare setting (HCWs) from high-risk exposure COVID-19 through Action Plan to remove barriers thus, implementing appropriate infection prevention and control precautions are critical for preventing transmission of COVID-19. In addition HCWs and patient in safe . consequently, the health care system should take precautions through action plan to avoid the completely collapse, leading to catastrophe affecting the entire country if the health ministry's negligence and lack of action toward medical staff.

### Aims of the study:

To suggest a forward action plan For adherence to Infection Prevention And Control To Health Care Workers During Care For Suspected Or Confirmed Covid-19 Patients At Hospitals based on gaps, weaknesses, and barriers from health care workers (HCWs) perspective.

### objectives:

1. Estimating rate of infection with COVID-19 among HCWs from their perspectives.
2. Evaluating adherence of HCWs to infection prevention and control during health care when COVID-19 is suspected or confirmed in health care setting.

3. Determining the most common weaknesses, and barriers face HCWs to adherence infection prevention and control in health care settings.
4. Suggest a forward action plan based on HCWs perspectives to cover gaps, weakness and barriers to control infection during care COVID-19 patient.

### Research Questions:

1. What is rate of infection with COVID-19 among HCWs?
2. Is there HCWs adherence to infection prevention and control during health care when COVID-19 is suspected or confirmed in health care setting?
3. What are the barriers face HCWs to adherence infection prevention and control in health care settings?
4. What is the forward action plan suggested from HCWs perspective with relation to gaps, weakness and barriers to control infection during care COVID-19 patient?

## Subjects and Methods

### The study designs

The present study is a cross-sectional study using a validated electronic questionnaire built-in Google drive and was distributed through sub site investigators in participating centers.

### The study setting

Governmental University and Quarantine Hospitals at different Cities (Zagazig city, Mansoura city, and Cairo city) in Egypt.

### Subjects:

The respondents of this study were HCWs who have been exposed to a patient with suspected or confirmed COVID-19 in healthcare institutions. Ideal sample size of HCWs was 439 from the previous mentioned settings. All those who were reachable and agreed to participate were included in the study.

### Data collection tools:

The instrument was constructed based on preliminary WHO interim guidance, 2020 and

review of the literature regarding infection prevention and control during health care of suspected or confirmed COVID-19 patients. The two tools were translated into Arabic for the better understanding of the participants. After translation, content validity of the questionnaire was confirmed by seeking the approval of seven experts from faculties of nursing at Egypt and infection prevention control committee members who were directors of the hospital. The opinions of the experts for each item were recorded on a two-point scale: agree, disagree.

**Tool number one included three sections:** *The first section* consists of personal and job characteristics of health care workers and it was used to collect data about age, gender, years of experience, civil status, and occupation etc. *The second section* incorporated (4) specific questions to estimate the COVID-19 infection rate among HCWs regarding contact with suspected or confirmed COVID-19 patient and these questions scored according to “yes”, “No”. *The third section* incorporated (6) sub-categories named; triage, early recognition, and source control, standard precaution for all patients, empiric additional precautions, wearing and removing protective equipment's, administrative controls, and environmental, engineering controls. It additionally reflected the adherence of HCWs to infection prevention and control during health care of suspected or confirmed COVID-19 patient.

This section used a two-point Likert scale, with item response scores ranging from 1 (No) to 2 (yes). The total score for each HCWs was calculated and converted into a % score, and was categorized into non-adherence if the score was <60% and adherence if the score was ≥60%. The fourth section assessed the barriers to applying preventive measures from the health care workers point of view.

**Tool number two:** It included ten barriers (Continuous change in guidelines related to infection control and the use of preventive measures). The health care worker's responses were measured on a two-point Likert scale ranged from yes (2) to No (1).

### Validity and reliability

The face validity of the questionnaire was tested by administering it to a group of approximately 10 HCWs to ensure that all terms used were understandable and to clarify any ambiguity. The modified final questionnaire was piloted on a small group HCWs (n=25) for a final check and assessment of clarity, time management, and consistence. Reliability was tested by reporting internal consistency and test-retest reliability. Test-retest reliability was conducted by re-administering the questionnaire to the same group of HCWs (n=25) within 14days' interval and reporting a measure of agreement. The Cronbach's alpha coefficient for the entire PSS were 0.960, 0.890, 0.890, 0.880, 0.900, 0.890 and 0.920 for (triage, early recognition, and source control, standard precaution for all patients, empiric additional precautions, wearing and removing protective equipment's, administrative controls, and environmental, engineering controls and barriers faced by HCWs to adherence of infection prevention and control, correspondingly), thus reflecting high reliability of internal consistency of the questionnaire.

The electronic self-assessment tool was used to collect the data included four sections.

### Ethical considerations

Ethical approval was obtained from the ethical research committee of nursing faculties in Mansoura University (Ref. No.p.0213) and Zagazig University. All subjects consented electronically by agreeing to participate before the start of the survey. Confidentiality of the collected data was maintained. The data collection took three months started from the beginning of April, 2020. It took about 20-30 minutes to fill the questionnaires.

***EQUATOR research checklist (STROBE) was used by the researchers.***

### Statistical Analysis

Data entry and statistical analysis was done using the statistical package for social science (SPSS) version 24.0. Data is present using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations

for quantitative variables. Cronbach alpha coefficient was calculated to assess the reliability of the tool. Pearson correlation analysis was used for assessment of the inter-relationships among quantitative variables. Statistical significance was considered at  $p$ -value  $<0.05$ .

## Results:

The study results were include 225 males and 214 females. The age of participating HCWs' ranged from 25 to 40 (66.7%) and 41.5% of them had more than 10 years of work experience. Concerning occupation, more than half (63.1%) of the respondents were nurses and nurse interns and 54.9% of HCWs were married . as regard to hospitals names the HCWS participant from Governmental University and Quarantine Hospitals at Zagazig City, Governmental University and Quarantine Hospitals at Mansoura City, Governmental University and Quarantine Hospitals at Cairo City, Unspecified hospital at Egypt as (33.3%), (29.6), (22.8), (14.3) respectively.(*Table 1*).

Regarding HCWs contact with suspected or confirmed COVID-19 patient, about 13.2% of HCWs were infected with COVID-19 (*Figure 1*). A large percentage of HCWs(94.5%) agreed about the signs posted in public areas reminding symptomatic patients to alert HCWs, followed by the use of screening questionnaires enforced according to updated case definition(90.7%).Overall, it showed high level of adherence (96.6%) in terms of isolating patients with suspected or confirmed COVID-19 (*Table 2*).

Responses about the precautions followed revealed that highest percent reported by studied HCWs (98.9%) were referred are HCWs wash their hands with soap and water when they are visibly dirty and HCWs use of personal protective measures help reduce the spread of infection. HCWs washed their hands with soap and water when they are visibly dirty and used personal protective measures to reduce the spread of infection. The HCWs frequently disinfected their hands with alcohol or water and soap(96.8%).Overall, high level of adherence(99.5%) in terms of applying standard precautions was observed (*Table 3*).

High adherence of HCWs with empiric additional precautions (99.8%) following contact and droplet (99.3%), airborne precautions for aerosol-generating procedures(97.0%) and collecting and handling laboratory specimens (99.1%) was observed (*Figure 2*).

Analysis of adherence to implementation of administrative controls showed that the highest percent reported by studied HCWs were related to the possibility of policies in place for early identification of acute respiratory infection caused by COVID-19 virus and HCWs prevent or reduce overcrowding especially in emergency departments(92.0%&90.2%). While the lowest percent (69.0% - 60.4) was related to adequate patient-to-staff ratio and adequate supplies of personal protective equipment provided. In general, the high level of adherence in terms of implementing administrative controls was 98.2% (*Table 4*).

The level of wearing and removing protective equipment by studied subjects was highly compliant with standard precautions in terms of general performance of wearing and removing protective equipment (*Figure 3*).

The highest percent reported by studied HCWs were related to clothes, food service utensils, and medical waste washed according to safe routines, surfaces cleaned with water and use of hospital disinfectants and cleaning and disinfection procedures are consistently and properly followed (94.8%, 94.5%& 94.1% correspondingly) (*Table 5*).

The barriers to application of preventive measures to control infection were related to lack of isolation rooms, sitting rooms and toilets (82.5%) and insufficient preventive equipment (80.9%), followed by inadequate training for health care workers on how to apply preventive measures also, insufficient spaces in hospitals to reduce overcrowding and ease of follow-up of patients inside the hospital (78.8% -74.0% respectively). The lowest barrier was infection control strategies leading to an increase in workload and stress (*Table 6*).

The correlation between HCWs adherence to infection prevention and control sub-

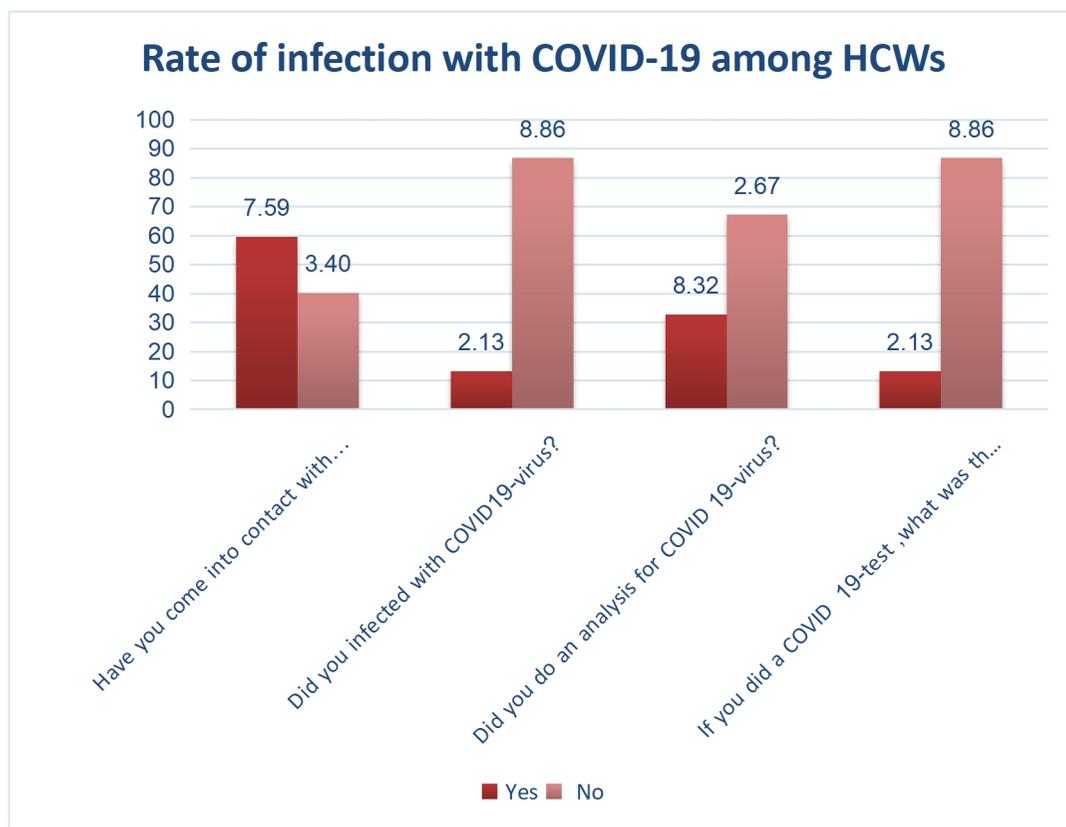
categories and HCWs age and years of experience is presented in (Table 7).

The results of the Pearson r test indicated significant correlation between standard precaution for all patients and age and year of experience were ( $r = 0.170^{**}$ ,  $p = 0.000$ ) and ( $r = 0.202^{**}$ ,  $p = 0.000$ ) respectively. There were

no The results of the Pearson r test indicated significant correlation between standard precaution for all patients and age and gender (Table 8). The forward action plan regarding barriers to applying preventive measures to control infection with COVID-19 is tabulated (Table 9).

**Table 1:** Distribution of Health Care Workers information's on interactions with suspected or confirmed COVID-19 patient (n= 439).

Health Care Workers information's	N	%
<b>Gender</b>		
Male	225	51.3
Female	214	48.7
<b>Age</b>		
< 25	128	29.2
25-40	293	66.7
>40	18	4.1
<b>Years of experience:</b>		
<5	132	30.1
5 to <10	125	28.5
>10	182	41.5
<b>Occupation:</b>		
Doctors	96	21.9
Nurse / Nurse intern	277	63.1
Other as(Pharmacists / Lab-technicians / Nutritionist/ X-ray technician)	66	15.0
<b>Civil status:</b>		
• Widower	19	4.3
• Unmarried	196	38.5
• Married	241	54.9
• Divorced	10	2.3
<b>Hospital name:</b>		
• Governmental University and Quarantine Hospitals at Zagazig City.	146	33.3
• Governmental University and Quarantine Hospitals at Mansoura City.	130	29.6
• Governmental University and Quarantine Hospitals at Cairo City.	100	22.8
• Unspecified hospital at Egypt.	63	14.3



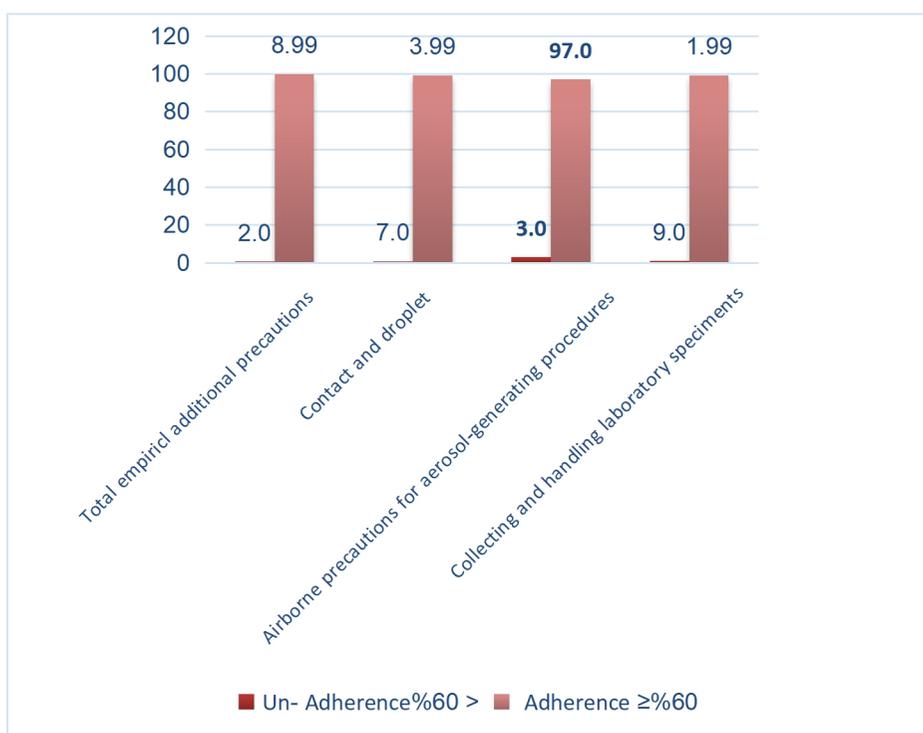
**Figure 1.**Therate of infection with COVID-19 among HCWs from your perspectives

**Table 2:** Adherence of HCWs to ensuring triage, early recognition, and source control (isolating patients with suspected or confirmed COVID-19) (n= 439).

Ensuring triage, early recognition, and source control:	Yes		No	
	N	%	N	%
• Are health care workers encouraged to reach the highest level of clinical suspicion?	387	88.2	52	11.8
• Has a well-equipped triage station been established at the entrance to the hospital with trained staff?	384	87.5	55	12.5
• Is the use of screening questionnaires enforced according to updated case definition?	398	90.7	41	9.3
• Are signs posted in public areas reminding symptomatic patients to alert HCWs and hand hygiene and respiratory hygiene are essential preventive measures?	415	94.5	24	5.5
Non-adherance < 60% = 3.4%				
Adherence ≥ 60% = 96.6%				

**Table 3:** Adherence of HCWs to applying standard precautions for all suspected or confirmed COVID-19 patients (n= 439).

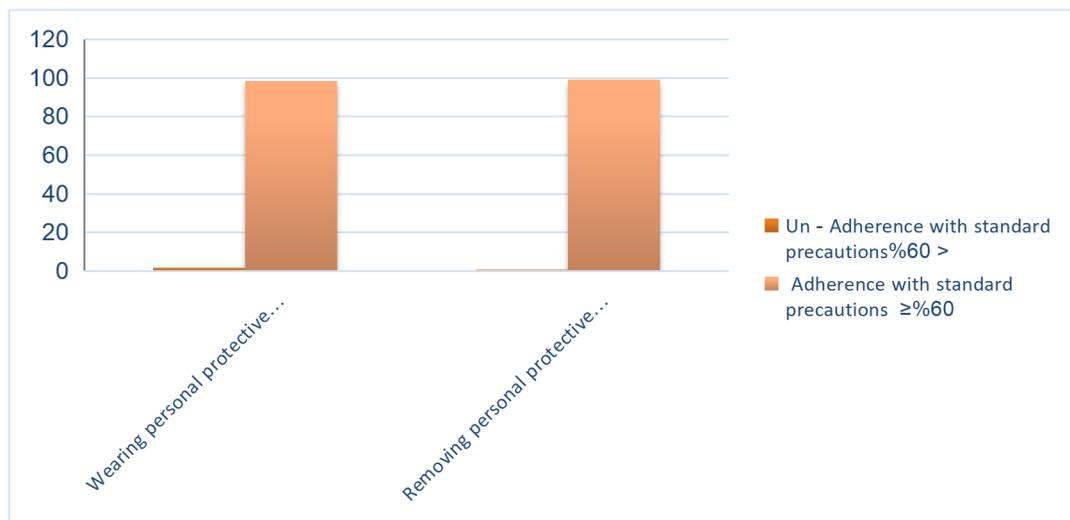
Applying standard precautions for all patients:	Yes		No	
	N	%	N	%
• Is it ensured that all patients cover their nose and mouth with a tissue or with the elbow when coughing or sneezing?	392	89.3	47	10.7
• Are patients suspected or confirmed of having COVID-19 provided with a medical mask while in public waiting areas?	381	86.8	58	13.2
• Are HCWs wash their hands after coming into contact with respiratory secretions?	419	95.4	20	4.6
• Do HCWs hands washed for 5 minutes?	391	89.1	48	10.9
• Do HCWs frequently disinfect their hands with alcohol or water and soap?	425	96.8	14	3.2
• Are HCWs wash their hands with soap and water when they are visibly dirty?	434	98.9	5	1.1
• HCWs use of personal protective measures help reduce the spread of infection?	431	98.2	8	1.8
Non-adherence < 60% = 0.5% Adherence ≥ 60% = 99.5%				



**Figure 2.** Adherence to implementing empiric additional precautions and sub- categories during health care suspected or confirmed COVID-19 patients.

**Table 4:** Adherence to implementing administrative controls as reported by studied subjects (n=439).

Implementing administrative controls:	Yes		No	
	N	%	N	%
• Are the policies in place for early identification of the possible acute respiratory infection caused by COVID-19 virus?	404	92.0	35	8.0
• Is there a mechanism to ensuring access to prompt laboratory testing for identification of the etiologic agent?	342	77.9	97	22.1
• Do HCWs prevent or reduce overcrowding, especially in emergency departments?	396	90.2	43	9.8
• Are designated waiting areas provided for symptomatic patients?	360	82.0	79	18.0
• Are patients isolated in hospitals properly and appropriately?	383	87.2	56	12.8
• Are adequate supplies of personal protective equipment provided?	265	60.4	174	39.6
• Are infection and infection control policies and procedures adhered to in all aspects of health care?	385	87.7	54	12.3
• Does the hospital provide adequate training for health care workers?	330	75.2	109	24.8
• Is there adequate patient-to-staff ratio?	303	69.0	136	31.0
• Are there a surveillance process for acute respiratory infections likely to be caused by the COVID-19 virus among healthcare workers?	328	74.7	111	25.3
• Is it ensured that that HCWs and the public understand the importance of promptly seeking medical care?	354	80.6	85	19.4
• Are HCWs compliance with standard precautions and providing mechanisms for improvement as needed?	394	89.7	45	10.3
Non-adherence < 60% = 1.8%				
Adherence ≥ 60% = 98.2%				

**Figure 3.** Level of HCWs adherence with standard precautions during wearing and removing protective equipments.

**Table 5:** Adherence to using environmental and engineering controls as reported by studied subjects (n= 439).

Using environmental and engineering controls:	Yes		No	
	N	%	N	%
• Is there adequate ventilation in all areas of the hospital and adequate environmental cleaning?	400	91.1	39	8.9
• Is a separation of at least one meter maintained between all patients?	401	91.3	38	8.7
• Is it ensured that cleaning and disinfection procedures are consistently and properly followed?	413	94.1	26	5.9
• Are surfaces cleaned with water and using commonly used hospital disinfectants (such as sodium hypochlorite) is effective and sufficient?	415	94.5	24	5.5
• Are clothes, food service utensils, and medical waste washed according to safe routines?	416	94.8	23	5.2
Non- adherence < 60% = 1.8%				
Adherence ≥ 60% = 98.2%				

**Table 6:** Barriers to applying preventive measures to control infection with COVID-19 from HCWs perspectives.

Barriers to applying preventive measures to control infection with COVID-19	No		Yes	
	N	%	N	%
9.1 Non-compliance with infection control regulations, policies and procedures	151	34.4	288	65.6
9.2 The continuous change in the guidelines related to controlling infection and the use of preventive measures	121	27.6	318	72.4
9.3 Infection control strategies increase workload and stress	179	40.8	260	59.2
9.4 inadequate support from the hospital administration	142	32.3	297	67.7
9.5 Lack of effective communication between health care workers	142	32.3	297	67.7
9.6 inadequate training for health care workers on how to apply preventive measures	93	21.2	346	78.8
9.7 lack of isolation rooms, sitting rooms and toilets.	77	17.5	362	82.5
9.8 insufficient spaces in hospitals to reduce overcrowding and ease of follow-up of patients inside the hospital.	114	26.0	325	74.0
9.9 Insufficient preventive equipments to be used while dealing with patients.	84	19.1	355	80.9
9.10 The influence of workplace culture on following infection control guidelines.	148	33.7	291	66.3

**Table 7:** Correlation between HCWs adherence to infection prevention and control sub-categories and HCWs age and years of experience.

Infection prevention and control sub-categories.	Pearson Correlation	Age	Years of experience
Triage, early recognition, and source control	Computed r	.105*	.145**
	P-value	.027	.002
standard precaution for all patients	Computed r	.170**	.202**
	P-value	.000	.000
Empiric additional precautions	Computed r	.087	.068
	P-value	.069	.154
Wearing and removing protective equipments.	Computed r	.089	.121*
	P-value	.063	.011
Administrative controls	Computed r	-.062-	-.067-
	P-value	.198	.158
Environmental and engineering controls	Computed r	.103*	.072
	P-value	.031	.134
Total infection prevention and control	Computed r	.073	.070
	P-value	.126	.143

Correlation is significant at the 0.01 level (2-tailed)

Correlation is significant at the 0.05 level (2-tailed).

**Table 8:** Correlation between HCWs adherence to infection prevention and control sub-categories and gender.

Infection prevention and control sub-categories.	Gender	M	SD	r	P-value
Triage, early recognition, and source control	Male (225)	7.5911	.79727	.032	0.857
	Female (214)	7.6262	.79344		
standard precaution for all patients	Male (225)	13.5200	1.17291	.986	0.321
	Female (214)	13.5701	.96036		
Empiric additional precautions	Male (225)	66.4667	5.16772	.769	0.381
	Female (214)	66.7430	4.41235		
Wearing and removing protective equipments.	Male (225)	17.5333	1.29215	1.034	0.310
	Female (214)	17.5841	1.03003		
Administrative controls	Male (225)	21.6533	2.93300	1.101	0.295
	Female (214)	21.6822	2.72563		
Environmental and engineering controls	Male (225)	9.6800	.86850	.348	0.555
	Female (214)	9.6355	.80366		
Total infection prevention and control	Male (225)	136.4444	10.15099	.414	0.520
	Female (214)	136.8411	8.95177		

**Table (9):** Examples of suggested a forward action plan based on gaps, weakness, and barriers from HCWs perspective to applying preventive measures to control infection during care COVID-19 patient.

Selected gaps and weakness	Action required& link to available tools/resources	Lead person & other team members	Timeline	Budget/resources
1- Lack of isolation rooms, sitting rooms and toilets.	<ul style="list-style-type: none"> <li>- Establish a contingency to use cohort areas within wards/cohort wards if available.</li> <li>- Plan and standardize procedures for patient placement in case of need for isolation.</li> </ul>	<ul style="list-style-type: none"> <li>•IPC lead</li> <li>•Clinical director</li> <li>• Head of nursing</li> </ul>	2-3 months	Low
2- Insufficient preventive equipment's to be used while dealing with patients.	<ul style="list-style-type: none"> <li>•Use of link nurses/practitioners can add extra human resource capacity as an interim measure and build IPC champions at the local level.</li> <li>• Consider task sharing to increase IPC capacity.</li> </ul>	<ul style="list-style-type: none"> <li>•IPC lead</li> <li>•Clinical director</li> <li>• Head of nursing</li> </ul>		
3- Inadequate training for health care workers on how to apply preventive measures.	<ul style="list-style-type: none"> <li>• Source competencies for IPC training and map to available staff.</li> <li>• Develop and submit a report on the competency status of available staff to senior managers highlighting gaps and the need to build capacity through training and mentorship.</li> <li>• Develop a programmed of IPC training using WHO training modules.</li> <li>-Develop a continuing professional development plan for IPC staff, considering gaps in competences (related to the IPC programmed).</li> <li>-Explore opportunities to have placements in other facilities where IPC implementation might be more advanced or specific projects have been successfully implemented. Identify national or international conferences or educational workshops.</li> <li>• In some countries, available professional development includes short training courses for new IPC practitioners (for example, two-week basic course for beginners), an advanced training course (for example, four-month course), a master's degree programmed for IPC practitioners (up to two years), as well as annual national seminars and conferences</li> </ul>	<ul style="list-style-type: none"> <li>• IPC lead/focal person</li> </ul>	3 months	Low
4- Insufficient spaces in hospitals to reduce overcrowding and ease of follow-up of patients inside the hospital.	<ul style="list-style-type: none"> <li>• Reduce family visits to hospital</li> <li>• Advice all people in the hospital about basic preventive measures hand-washing.</li> <li>• Monitor body temperature of everyone in hospital regularly</li> <li>• Avoid group interaction activities</li> </ul>	<ul style="list-style-type: none"> <li>• IPC lead working with heads of departments</li> </ul>	3 months	Moderate

## Discussion

Infection prevention and control priorities include four main items: 1) rapid identification of suspected cases through testing at the initial counter between patients and HCWs and application of infection control measures 2) immediate isolation and referral for testing by grouping patients with suspected or confirmed COVID-19 separately and discontinuing isolation for those clinically improved patients who test negative by PCR; 3) safe clinical management and immediate identification of inpatients and HCWs with suspected COVID-19; and finally 4) adherence to IPC practice with appropriate use of Personal Protective Equipment (PPE) (Lacotte et al., 2020). Infection prevention practices and control are critical activities that influence the quality of health care services. The present study aimed to assess measures adopted by healthcare institutions whenever a COVID-19 case was suspected or confirmed.

The result of the present study demonstrated the strengths of the government university and quarantine hospitals. It showed adherence of HCWs to triage, early recognition, and source control, standard precaution for all patients. However, gaps and weakness and the preventive measures barriers to control infection with COVID-19 were identified. Hence, a forward action plan was suggested after referring to the literature.

The HCWs are always at risk of getting infected with COVID-19 in the workplace and in the present study; about 13.2% had COVID-19 infection. This can be attributed to a relatively lower threshold to perform SARS-CoV-2 tests in HCWs that led to higher testing of minimally symptomatic workers compared to the general population especially in the earlier weeks of the epidemic when testing was limited and individuals in the community with mild disease were not yet eligible for testing. In a study conducted earlier at 12 hospitals and medical centers in Cairo reported 46 % of infected HCWs had contact with a suspected case and 27.6% of HCWs contact within 2 m with a confirmed COVID 19 patient, in addition the proportion of infection among symptomatic HCWs was 8.8% (Mostafa et al.,

2020). This was different from that reported in Washington, where about 5.3% of symptomatic HCWs tested positive for COVID19 (Mani et al., 2020).

The finding of the present study showed that the HCWs agreed that signs posted in public areas to alert HCWs and take essential preventive measures by symptomatic patients prevent transmission so that patients continue to safely require access to essential health services. Healthcare settings will act as additional source of transmission and spread of COVID-19 in the society, sufficient precautions are not taken (Devrim and Bayram, 2020). The infection control precautions should be updated according to the management practices/guidelines on COVID-19.

Regarding adherence of HCWs to applying standard precautions for all suspected or confirmed COVID-19 patients, a high level of adherence with respect to application of precautions for all suspected or confirmed COVID-19 was observed. HCWs washed their hands with soap and water when they were visibly dirty and used personal protective measures to help reduce the spread of infection, in addition, they disinfected their hands with alcohol.

This may be related to the awareness of HCWs on hand washing to prevent transmission of pathogens associated with hospital care. Regular updates through continuing education should be given to improve the attitudes. Preferably, nurses, clinicians and laboratory staff should have the highest compliance. A study on the HCWs in a Chinese Mental Health Center reported evaluation and comparison of knowledge of nosocomial infection control, use of personal protective equipment, hand hygiene compliance and accuracy and disinfection and sterilization effectiveness between pre- and post-intervention. Implementation of the prevention and control measures led to significant improvements (Yang et al., 2020). The findings provide empirical evidence for the effectiveness of the COVID-19 preventive strategies. In Minia City (Egypt), a large of percentage of HCWs (85%) was happy about standard precautions (Refeai et al., 2020). These reports agree with the saying "*Doing any less*

wouldn't make human or economic sense". Adequate hand hygiene would ensure prevention of nosocomial spread not only from patient to patient through contaminated HCW hands, but also from patients to HCWs (Peters et al, 2020). HCWs in a tertiary Hospital in Wuhan (China) had a higher rate of infection, especially among nurses working in the low-contagion area during the early stage of the disease outbreak. This was due to insufficient protective measures available in clinical departments that could have put non-first-line HCWs at a higher risk (Lai et al, 2020). The present study indicated that most HCWs (60.0%) were infected during the early stage of the COVID-19 outbreak.

Regarding adherence to implementing empiric additional precautions and sub-categories during health care suspected or confirmed COVID-19 patients showed high adherence of HCWs with empiric additional precautions sub categories as the following contact and droplet (99.3%), airborne precautions for aerosol-generating procedures (97.0%). Overall, there was high level of adherence (99.8%) in terms of implementing empiric additional precautions for suspected or confirmed COVID-19 patients. Nosocomial transmission of SARS-CoV-2 happens via droplets, aerosols, and the oral-fecal or fecal-droplet route (Islam et al, 2020). However, the IPC guidelines did not cover all the transmission modes, and the recommendations were contradictory to each other. WHO added that most guidelines recommend surgical masks for healthcare providers during routine care and N95 respirators for aerosol-generating procedures. However, the CDC recommends cloth masks wherever surgical masks are unavailable.

About implementation of administrative controls, the finding of the present study showed that the majority of studied HCWs were related to the possibility of policies in place for early identification of acute respiratory infection caused by COVID-19 virus and HCWs prevent or reduce overcrowding, especially in emergency departments in that order. While, the lowest percent was related to adequate patient-to-staff ratio and adequate supplies of personal protective equipment provided. In general, it

was revealed that high level of adherence in terms of implementing administrative controls. This may be related to additional training and information about COVID-19, including recognizing signs and symptoms of infection and ways to prevent exposure to the virus. Training includes information about how to implement the various infection prevention and control. HCWs who reported that Implement policies that promptly inform local or state health authorities about suspected or confirm case of COVID-19, and who suggested to designate team or person from the facility who are responsible for collecting and dissemination of information to public health authorities and HCWs within facility (Sharma et al., 2020; Otieno-Ayayoet al., 2015).

In addition, adequate level of staffing is crucial to maintain patient care during the ongoing COVID-19 pandemic (Bielicki et al, 2020). The Latin American countries have been profoundly affected by COVID-19. Investigation on 225 self-selected participants to investigate knowledge, perception and attitudes with regard to COVID-19 reported lack people's confidence on the sanitary responses (62.7%), preparedness for the disease (76.9%) and the lack of adequate measures to deal with it (51.1%) (Zegarra-Valdivia et al., 2020). It suggests that public policies consider guidelines on update knowledge.

Regarding using environmental and engineering controls, there was highest percent reported by studied HCWs were related to clothes, food service utensils, and medical waste washed according to safe routines, surfaces cleaned with water and using commonly used hospital disinfectants and cleaning and disinfection procedures are consistently and properly followed. On the whole, it was revealed that high level of control in terms of using environmental and engineering controls. This may be related to using basic health-care facility infrastructures. Spatial separation of at least 1-meter distance should be maintained between each suspect patient and others. Strict adherence to evidence-based guidelines for PPE and environmental hygiene given by CDC and World Health Organization enhances the safety and improves the mitigation of infection. Nevertheless, these recommended measures

might optimize the healthcare services provided to confirm COVID-19 patients and should reduce the risk of occupational transmission to other patients and healthcare professionals (Awad et al., 2020).

Assessment of barriers to applying preventive measures to control infection with COVID-19 from HCWs perspectives showed that the most of this barriers were related to lack of isolation rooms, sitting rooms and toilets and insufficient preventive equipment's, followed by inadequate training for health care workers on how to apply preventive measures also, insufficient spaces in hospitals to reduce overcrowding and ease of follow-up of patients inside the hospital. This results relates to an increase in the number of infected cases due to lack of rooms for isolation. Other important practical measures described by healthcare workers included minimizing overcrowding, fast-tracking infected patients, restricting visitors, and providing easy access to hand washing facilities. Lack of PPE and poor quality of equipment was a serious concern for healthcare workers and managers. Among ten identified barriers, lack of resources for implementing public health and social measures was found to be the biggest barrier for implementation of public health and social measures for preventing transmission of COVID-19 in earlier studies (Maqbool and Khan 2020). Other barriers reported by the health care workers (HCWs) included frequent shortage of water, and inactive infection control committee (Otieno-Ayayo et al, 2015).

Regarding correlation between HCWs adherence to infection prevention and control sub-categories and age and year of experience of HCWs, there was statistically significant difference in correlation. The age, and years of experience of HCWs are more competent in decision making due to the background information and enthusiasm that make them tolerate, responsible, and have cognitive skills to promote their work through managing decision making related to protection. Also the workplace and career of staff affect decision making through cognitive processes such as information and processing them, problem-solving, judgment, memory, and learning interpreting and responding to decision-making tasks.

Studies have shown that the young nurses and medical HCWs being more knowledgeable about PPE than the older senior colleagues (Wang et al., 2020; Nofal et al, 2017). The results of the present study were in agreement with earlier findings. Analysis of correlation between HCWs adherence to infection prevention and control sub-categories and gender indicated no significant correlation. This result was similar to an earlier that showed no relationship with individual factors (Yassi et al. 2007). This indicates how people are able to control their emotions and their relationships and help to develop better understanding and therefore a better relationship with the community. Significant statistical differences were found in mean practice scores only in relation to gender ( $F = 8.569$ ) at  $p < 0.05$  (0.004). (Ayed, 2015).

### **Conclusion:**

The HCWs from the government university and quarantine hospitals, early recognition, and source control, standard precaution for all patients, empiric additional precautions, wearing and removing protective equipment's, administrative controls, and environmental, engineering controls. But a number of gaps and weakness were identified along with barriers to applying preventive measures for the infection prevention and control. Hence, forward action plan based on review of literature have been suggested.

### **Recommendation:**

1. We suggest implement the action plan for adherence to infection prevention and control to health care workers during care for suspected or confirmed Covid-19 Patients at Hospitals, disseminated to all Hospitals, reviewed, revised and updated periodically as appropriate and as necessary.
2. Repeat assessments are recommended in order to correct actions and maintain an adequate response to the COVID-19 pandemic. In order to best evaluate the facility's improvement opportunities.

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