

# Knowledge, perception, and confidence of healthcare workers about COVID-19 preventive measures during the first wave of the pandemic: a cross-sectional study from Egypt

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## Abstract

**Introduction** The ongoing coronavirus-disease-19 (COVID-19) pandemic had a variable history with differences in its various stages. This study evaluates the status of knowledge, perception, and confidence about COVID-19 preventive measures during the first wave of the COVID-19 pandemic among healthcare workers (HCWs) in Egypt.

**Methods** A cross-sectional study was conducted during the first wave of the COVID-19 pandemic, in July 2020, in Egypt. An online-based questionnaire was used to collect data. It included items to record demographic data, and an assessment of knowledge, the perception of healthcare facilities preparedness, and HCW confidence about applying infection prevention measures.

**Results** A total of 465 responses were analyzed. HCWs' mean age was  $36.76 \pm 9.57$  years, 94.2% (n=438) had an adequate level of knowledge, 31% (n=144) had an adequate perception level, and 39.4% (n=183) had an adequate confidence level. The main source of information was international organizations' websites 46.5% (n=216). The main barriers to applying preventive measures were the overcrowding of patient care areas 73.1% (n=339), and limited infection control supplies 68% (n=316). Factors associated with COVID-19 among HCWs were COVID-19 infected family members (OR: 5.86), inability to protect themselves and their families (OR: 5.73), uncertainty about the available hand hygiene supplies (OR: 3.76), male gender (OR: 3.07), and single HCWs (OR: 2.88).

**Conclusions** Although the majority reported an adequate knowledge level, lower rates of adequate perception and confidence were observed. Revision of preparedness plans in different facilities should be further studied. Psychological support and gender differences should be considered in response programs.

**Keywords** Patient care, hand hygiene, infection prevention and control, health provision, low- and middle-income, barriers.

## Introduction

The coronavirus-disease-19 (COVID-19) outbreak started in China and has rapidly evolved into a pandemic. Healthcare workers (HCWs) are on the front lines of this global crisis and are at great risk of infection. In Egypt,

179,407 confirmed cases of COVID-19 with 10,443 deaths were recorded up to the 24<sup>th</sup> of February 2021.<sup>1</sup> The infection proportion among HCWs in Egypt was reported in earlier reports ranging from 3.7% to 20% in different healthcare settings.<sup>2,4</sup> The protection of HCWs is a priority in all countries, particularly as

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governments scramble to increase healthcare capacity to cope with the influx of patients needing urgent care.<sup>5,6</sup>

The global COVID-19 pandemic has demonstrated the value of reinforcing health systems with efficient infection prevention and control programs.<sup>7</sup> The complex healthcare delivery system in low-middle-income countries (LMICs), e.g., Egypt, with the inadequate supply of services and understaffing in many hospitals contribute to the difficulties of controlling COVID-19 spread at health provision settings.<sup>8</sup>

In Egypt, the need for proactive preventive measures to control the spread of COVID-19 among HCWs was underscored earlier.<sup>3</sup> Several researchers have attempted to investigate the knowledge, perception, and confidence of HCWs regarding COVID-19,<sup>7,8</sup> with not enough data about prevention actions. To fill the knowledge gap, this study assesses the status of knowledge, perception, and confidence about COVID-19 preventive measures during the first wave of the pandemic in Egypt.

## Methods

This cross-sectional study was conducted during the first wave of the COVID-19 pandemic in Egypt. The target population was the Egyptian HCWs (physicians, pharmacists, nurses, dentists, and technicians) who were on duty from the start of the COVID-19 pandemic announcement (December 2019) until July 2020. The study was conducted according to the international guidelines for Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). The institutional review board of the Faculty of Medicine, Zagazig University approved the study protocol with approval no: ZU-IRB # 6248-5-7-2020. The questionnaire included an introduction explaining the purpose of the study,

an introduction to the responsible research team, and guarantee the confidentiality of the data and ensuring that it is used exclusively for research. We stated that agreeing to complete the questionnaire is the implicit approval of participants to share in the study.

The sample size was calculated using open EPI-Info (Epidemiological Information Package) software by assuming the probability of having good knowledge among HCWs was 80.3%, at the 99% confidence interval, the limit of precision of 5%, with a design effect of 1.0. The calculated sample size was 419 HCWs.<sup>9</sup>

Respondents were eligible to participate if they accepted to complete the questionnaire. HCWs who were not on duty during the first wave of the COVID-19 pandemic were excluded from the study.

A questionnaire was constructed after a review of the literature.<sup>5,7,8,10,11</sup> The questionnaire was piloted on 30 participants who were excluded later from the study sample to determine acceptability and the clarity of questions, and to confirm its face validity; it was then modified accordingly.

The questionnaire included four parts. The first part covered demographic, educational, and work-related characteristics, their role in care provision, the main source of information for COVID-19 preventive measures, previous education and training on infection prevention and control (IPC), exposure to COVID-19 patients, and status of COVID-19 infection up to July 2020. The second part included 10 items, measuring healthcare professionals' knowledge about COVID-19 preventive measures. The third part included 11 items assessing healthcare professionals' perception of their hospital preparedness for COVID-19 prevention. The fourth part included 7 items assessing healthcare professionals' confidence toward applying COVID-19 infection control measures. It took 10 min to fill the questionnaire.

We created an online version of the survey using Google forms. Members of the research team were asked to disseminate the survey via their networks. Other dissemination strategies involved social media communication channels. Respondents were encouraged to send the

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questionnaire link to their colleagues. We invited many HCWs from different healthcare facility types to participate in the study. Responses were collected anonymously, from the 7<sup>th</sup> until the 22<sup>nd</sup> of July 2020. The survey portal was closed when the number of participants became 495.

### Statistical analysis

Analysis was done using SPSS (Statistical Package for Social Sciences) version 20 software (IMB Corp., USA). Descriptive statistics were presented using means and standard deviations for continuous variables, frequencies, and percentages for categorical variables. Comparisons were initially performed using a Chi-square test; variables that in univariate analysis were associated with COVID-19 with a p value <0.05 were included in a binary logistic regression model. The association was then reported as odds ratios (OR) with their correspondent 95% confidence intervals (95% CI). The statistical significance level was set at a p value <0.05.

For assessing knowledge, we gave a score of one point if the right answer was chosen and a score of zero if the wrong answer or “do not know” was chosen. A total of ≥6 points (≥60% of total marks) was considered adequate knowledge. For assessing each perception and confidence, we gave a score of 2 to 0 to each item according to the choice on the used scale (agree, neutral, or disagree). A total of ≥13 points (≥60% of total marks) was considered adequate perception. For assessing confidence, a total of ≥8 points (≥60% of total marks) was considered adequate.<sup>12</sup>

### Results

A total of 495 HCWs completed the online questionnaire. After exclusion of ineligible cases (not on duty during the first wave of the COVID-19 pandemic), 465 HCW responses were analyzed. The participants' demographic and work-related characteristics are shown in Table 1. The mean age of the participants was 36.76 ± 9.57 years, 63.4% (n=295) were female, and 70.3% (n=327) were single. Most respondents had a bachelor's degree 32.7% (n=152), and 72.3% (n=336) were physicians/dentists. Overall, 5.2% (n=24) had less than 10 years of work

experience. Different types of healthcare facilities were represented. The majority of HCWs, 79.8% (n=263) were frontline workers (in direct contact with patients with COVID-19 during care provision).

**Table 1. Socio-demographic and work-related characteristics of the study participants**

Variable	N	%
<b>Age</b>		
20 to <35	241	(51.8)
35 to <50	159	(34.2)
≥50	65	(14.0)
<b>Gender</b>		
Male	170	(36.6)
Female	295	(63.4)
<b>Marital status</b>		
Single	138	(29.7)
Married	327	(70.3)
<b>Level of education</b>		
Bachelor	152	(32.7)
Diploma	49	(10.5)
Master	133	(28.6)
Doctorate	110	(23.7)
Others	21	(4.5)
<b>Occupation</b>		
Physician/dentist	336	(72.3)
Pharmacist	54	(11.6)
Paramedical	75	(16.1)
<b>Work experience</b>		
<5 years	118	(25.4)
6-10	125	(26.9)
11-15	81	(17.4)
16-20	51	(11.0)
>20 years	90	(19.4)
<b>Type of healthcare facility/unit</b>		
Dentistry	113	(24.3)
Pharmacy	107	(23.0)
Medical departments in hospital	115	(24.7)
Surgical departments in hospital	66	(14.2)
Intensive care services/Emergency services	64	(13.8)
Others	26	(6.0)
<b>Providing patient care</b>		
Non-frontline	212	(45.6)
Frontline	263	(56.6)

A percentage of 63% (n=293) of participants gave a history of current or past infection by SARS-CoV-2; 5.5% (n=26) of infected cases had been confirmed by PCR. A total of 52.7% (n=245) had a previous exposure with COVID-19 patients. HCWs reported a history of COVID-19 among family members.

A total of 62.2% (n=289) HCWs attended IPC training or education sessions, and 35.9% (n=167) received training on COVID-19 IPC measures. Only 8% (n=37) of participants held an IPC degree (master, a diploma, or training certificate). The majority of HCWs, 63% (n=293) reported that they used to apply infection control measures in their routine practice before the COVID-19 pandemic.

#### Respondents' level of knowledge about COVID-19

Knowledge items about COVID-19 preventive measures is presented in Table 2. Overall, 94.2% (n=438) of HCWs had an adequate level of knowledge and 5.8% (n=27) HCWs had an inadequate level.

Sources for infection prevention information during the pandemic are presented in Figure 1, with 46.5% (n=216) of participants reporting international organizations' websites such as

Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) as their main source.

#### Respondents' perceptions toward healthcare facility preparedness to combat COVID-19

The perception of HCWs about the preparedness of their healthcare facilities to control COVID-19 is summarized in Table 3, 69% (n=321) of HCWs had inadequate perception level and 31% (144) HCWs had an adequate level.

#### Respondents' confidence in applying COVID-19 IPC in their practice settings

The perception of HCWs about their self-confidence in applying infection control COVID-19 is summarized in Table 4: 39.4% (n=183) of HCWs showed adequate confidence level, and 60.6% (n=282) showed inadequate confidence level.

**Table 2. Healthcare workers' knowledge about infection control practice of COVID-19**

Item assessing knowledge	Answer		
	Correct N (%)	Wrong N (%)	Don't know N (%)
It is important that all HCWs have their temperature measured daily before entering the hospital? (True)	401 (86.2%)	44 (9.5%)	20 (4.3%)
It is recommended to isolate a patient with confirmed COVID-19 and those under investigation for COVID-19 in airborne infection isolation room with exhaust? (True)	32 (6.9%)	372 (80.0%)	61 (13.1%)
All patients and visitors have to wear (medical or cloth masks) upon entry into the healthcare setting (True)	452 (97.2%)	10 (2.2%)	3 (0.6%)
Physical distancing between people (maintaining 6 feet between people) is important to prevent COVID-19 transmission (True)	453 (97.4%)	6 (1.3%)	6 (1.3%)
Preferred method of hand hygiene for visibly soiled hands is the use of alcohol-based hand sanitizer with at least 60% alcohol (False)	151 (32.5%)	291 (62.6%)	23 (4.9%)
It is recommended that HCWs should wear a facemask at all times while they are in the healthcare facility (True)	412 (88.6%)	41 (8.8%)	12 (2.6%)
Currently the most effective method for prevention of COVID-19 infection in the healthcare setting is chemoprophylaxis e.g., chloroquine. (False)	336 (72.3%)	49 (10.5%)	80 (17.2%)
Healthcare providers in the triage area should be trained to spot symptoms of a potential COVID-19 infection such as cough, fever and difficulty breathing (True)	454 (97.6%)	6 (1.3%)	5 (1.1%)
When should hand hygiene be done? (5 moments indications)	418 (89.9%)	47 (10.1%)	-
What PPE would you recommend when transporting suspected COVID-19 patients?	289 (62.2%)	176 (37.8%)	-

HCWs – healthcare workers; PPE – personal protective equipment.

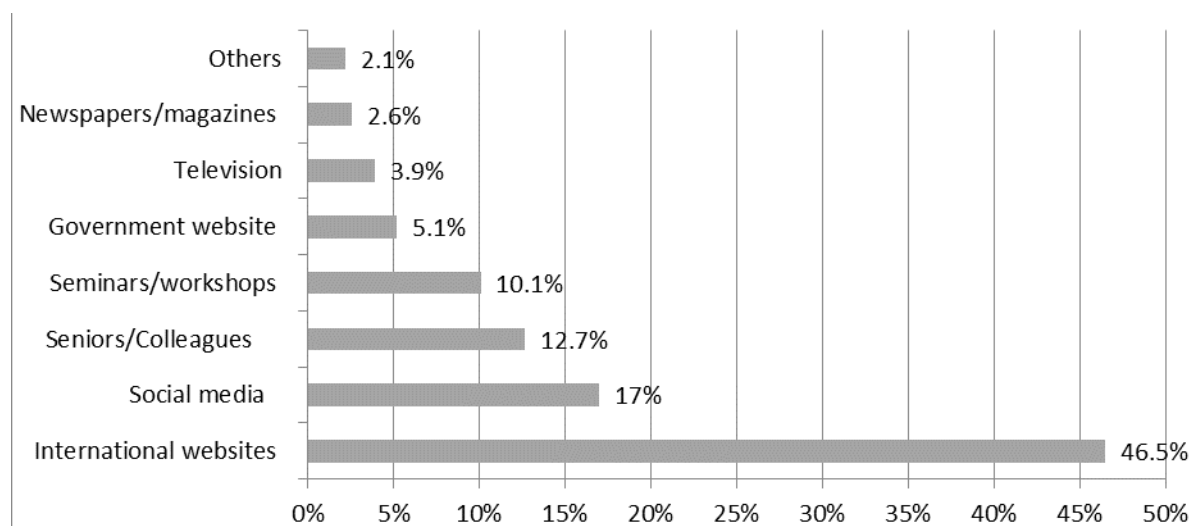


Figure 1. The main sources for information about infection control measures of COVID-19

Table 3. Healthcare workers' perception about the preparedness of their hospitals for infection prevention and control of COVID-19

Perception of healthcare workers	Disagree N (%)	Neutral N (%)	Agree N (%)
The health facility where I work is well equipped/prepared to manage COVID-19 infection control	169 (36.3%)	191 (41.1%)	105 (22.6%)
I have received sufficient training in IPC specifically for COVID-19	202 (43.4%)	164 (35.3%)	99 (21.3%)
All healthcare professionals in my facility follow IPC measures	148 (31.8%)	181 (38.9%)	136 (29.2%)
All healthcare providers in my facility can care for COVID-19 patients and protect themselves from infection	183 (39.4%)	165 (35.5%)	117 (25.2%)
Supply of personal protective equipment at work is sufficient for healthcare workers	166 (35.7%)	152 (32.7%)	147 (31.6%)
The hand hygiene supplies are sufficiently available to all personnel in the health facility where I work	149 (32.0%)	115 (24.7%)	201 (43.2%)
Everyone at my work place has an easy access to COVID-19 infection control policies	124 (26.7%)	157 (33.8%)	184 (39.6%)
I can easily access PPE in the healthcare facility where I work	166 (35.7%)	159 (34.2%)	140 (30.1%)
In the health facility where I work there are a sufficient number of well-equipped isolation rooms for patients with suspected COVID-19	202 (43.4%)	165 (35.5%)	98 (21.1%)
The health facility where I work receives adequate support from national/regional/local public health authorities, who provide guidance and training on how to manage COVID-19	161 (34.6%)	177 (38.1%)	127 (25.8%)
The healthcare facility where I work provides a protocol for early detection of infected cases among healthcare providers	178 (38.3%)	149 (32.0%)	138 (29.7%)

IPC – infection prevention and control.

#### Perceived barriers to apply IPC measures during the COVID-19 pandemic

The top main perceived barriers facing the application of IPC measures during the COVID-19 pandemic were the overcrowding of patient care areas in 73.1% (n=340) of cases, limited IPC supplies 68% (n=316), insufficient training 66.9% (n=311), the shortage of PPE 66.2%

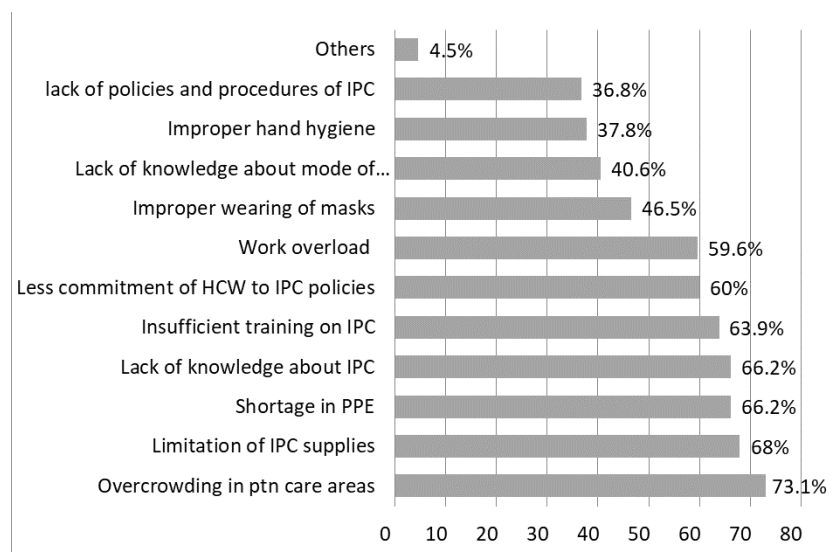
(n=308), and lack of knowledge 66.2% (n=308) – Figure 2.

In Table 5, the regression model shows the following factors were significantly associated with the occurrence of infection: HCWs who had a COVID-19 infected family member had about 5.86 times greater risk of developing an infection than those with no family history (OR: 5.86; 95% CI: 2.667-12.878). HCWs who could not protect



**Table 4. Perception of healthcare workers' confidence in applying COVID-19 infection prevention and control in their practice settings**

Item of self-confidence	Disagree N (%)	Neutral N (%)	Agree N (%)
I can correctly put on and take off personal protective equipment to prevent transmission of COVID-19 to others and myself	58 (12.5%)	129 (27.7%)	278 (59.8%)
I am confident of my knowledge about COVID-19 prevention	37 (8.0%)	184 (39.6%)	244 (52.5%)
I can identify reliable sources of information regarding COVID-19 preventive practices	39 (8.4%)	142 (30.5%)	284 (61.1%)
I can educate others on appropriate infection prevention and control measures	55 (11.8%)	159 (34.2%)	251 (54.0%)
I can protect myself and my family from COVID-19 infection	67 (14.4%)	202 (43.4%)	196 (42.2%)
I can protect my patients from COVID-19 Infection	79 (17.0%)	216 (46.5%)	170 (36.6%)
I am confident in getting the needed support from senior medical/nurse staff to apply recommended infection prevention and control measures	106 (22.8%)	185 (39.8%)	174 (37.4%)

**Figure 2. Barriers to applying infection control measures during COVID-19**

themselves and family from COVID-19 infection had 5.73 times higher odds of developing COVID-19 than those who could protect themselves (OR: 5.73; 95% CI: 1.763-18.656). HCWs who could not determine whether hand hygiene supplies were sufficiently available at their workplace were 3.76 times at higher risk of getting an infection (OR: 3.76; 95%CI: 1.275-11.089). Male HCWs had a 3.07 times higher risk of getting an infection than female colleagues (OR: 3.07; 95% CI: 1.389-6.783). Single HCWs were 2.88 times at higher risk to get COVID-19 than married ones (OR: 2.88; 95%CI: 1.327-6.271).

### Discussion

Healthcare workers are key players in the battle against COVID-19. In LMICs, there are major gaps in response capabilities, particularly in human resources and facility preparedness.<sup>4</sup> As the ongoing pandemic had a variable history, with differences in its various stages, the study evaluated the status of knowledge, perception, and confidence about COVID-19 preventive measures among HCWs during the first wave of the COVID-19 pandemic in Egypt. Comparing between knowledge, preparedness and confidence all through the pandemic course helps healthcare authorities to modify the

**Table 5. Logistic regression analysis of the factors associated with COVID-19 among healthcare workers**

Variable	P value	OR	95% CI	
			Lower	Upper
Gender	0.006*	3.070	1.389	6.783
Marital status	0.008*	2.884	1.327	6.271
Attendance to COVID-19 infection control courses	0.074	0.487	0.221	1.073
Apply infection control measures in routine practice before the COVID-19 pandemic	0.436	1.355	0.631	2.907
Have COVID-19 infected family members	<0.001*	5.861	2.667	12.878
Use alcohol-based hand rub for visibly soiled hands	0.194	1.829	0.735	4.550
Uncertainty about sufficiently available hand hygiene supplies	0.048*	3.76	1.275	11.089
Unable to protect self and family from COVID-19 infection	0.013*	5.73	1.763	18.656

preparedness plans. Adding, addressing defects or successes during the first wave will help to adjust the ongoing national prevention program.

Lack of HCWs' awareness about emerging infections and their need for more training was previously reported.<sup>13</sup> During the COVID-19 outbreak, higher rates of adequate awareness about IPC measures were reported from many countries e.g., Egypt (80.2%),<sup>14</sup> Uganda (70%),<sup>15</sup> India, (65.5%),<sup>16</sup> (94.8%) Pakistan,<sup>17</sup> and (79.7%) Saudi Arabia.<sup>18</sup> In the current report, higher rates were recorded, with most HCWs showing an adequate level of knowledge. This may be due to the use of credible information sources. In this study, half of HCWs used international organizations' websites as their main source of IPC knowledge. In earlier studies, 27-60% relied on WHO websites.<sup>13</sup> Many international organizations released guidance and launched online training courses to raise awareness and prepare people for COVID-19 control.

As part of the COVID-19 response program, identifying the defect/missed knowledge items help the national authorities to deliver a proper educational message for HCWs. In this report, most HCWs did not identify the use of negative pressure rooms in COVID-19 isolation, which we attributed to the limited use of such rooms in Egypt. Yet the remarkable finding is that more than half of the respondents did not identify the correct method of hygiene for visibly soiled

hands, we need to correct this concept to avoid the misuse of alcohol rub and to maximize the benefit of hand hygiene practice during the pandemic.

The preparedness of the healthcare facilities in crisis times is a huge challenge. Even advanced healthcare systems, such as those in Italy, Spain, and China, were flooded with COVID-19 patients.<sup>19</sup> Nearly one-third of study participants consider that their facilities are well prepared to prevent COVID-19. Similar rates were reported from HCWs in low-income countries (31%) versus higher rates for HCWs from high-income countries, (71.8%).<sup>6</sup> Revising the implemented preparedness measures is needed. Continuous preparedness assessment and managerial support are essential for detecting gaps and subsequent implementation of corrective measures.<sup>20</sup> Moreover, it is appropriate to consider involving HCWs in the decision-making process for outbreak management to improve their perception. Health workers in African countries like Egypt have a strong voice in local communities<sup>4</sup> and their acceptance for implementation can be gained if they are actively engaged in the process of disease control.

Healthcare systems should ensure that all HCWs feel confident to manage newly emerging threats. Unfortunately, only 39.4% (n=183) of HCWs were confident in their ability to apply proper IPC measures during COVID-19. Work

overload and failure to cope with the rapidly changing information about COVID-19 is a reason for lack of confidence.<sup>20</sup> Their low perception of healthcare facilities' preparedness is another possible explanation.

In this study, many HCWs perceived the main obstacles to implement IPC during COVID-19 are overcrowding in patient care areas and insufficient supplies of infection control. Similar results have been reported by Catherine et al., 2020.<sup>21</sup> Various low-cost measures, such as facemasks for patients with respiratory problems, cough etiquette, hand washing, and proper physical distancing, cleaning, can help to mitigate the risk of infection spreading to HCWs in hospitals.<sup>4</sup>

Determining the risk of COVID-19 spread among HCWs can be the first step in determining the best monitoring and evaluation strategy. It will be critical to account for such associated risk factors when planning effective intervention strategies.<sup>22</sup> We reported some factors associated with COVID-19 among Egyptian HCWs: having an infected family member increases the likelihood of infection five times, this emphasized healthcare personnel should recognize potential exposures unrelated to patient care and use prevention measures.<sup>23</sup> Another factor associated with COVID-19 among HCWs is lack of HCWs confidence to protect themselves and their families. In their study about stigma among Egyptian HCWs, Mostafa et al.<sup>5</sup> reported self-stigma (HCWs felt bad about exposing their families to COVID-19) and associative stigma (if they were in regular contact with COVID-9 patients, HCWs believed they should stay away from their families until the crisis passed). Stigma can discourage them from adopting healthy behaviours.<sup>24</sup> This underscores the role of psychological support in COVID-19 control plans. Increased likelihood of COVID-19 among male HCWs reflects the workload in Egypt. There was a previously raised concern that pandemic responses that ignore gender differences and norms would be ineffective. Regenold and Vindrola-Padros<sup>25</sup> confirmed the importance of using a gender lens when

considering policy, experiences, and impacts of COVID-19.

The current research has a range of possible limitations. First, there may be a selection bias. Although the survey was widely distributed, the study sample was a convenient sample of all HCWs in Egypt. Second, this study was an online survey. Responses depended on honesty. The recall ability could affect the responses.

### Conclusions

An adequate knowledge level about preventive measures was observed among most HCWs, their main source of information was international organizations' websites. However, many HCWs were confident in their ability to apply preventive measures and a lower rate had an adequate perception about the preparedness of their facilities to prevent COVID-19. Revision of preparedness plans in different facilities should be further studied with more engagement of HCWs in decision making at facility level. Psychological support programs for HCWs should be supported and properly implemented in different healthcare settings. Gender differences should be considered in response programs.

**Authors' contributions statement:** ED, RE, OE, SE, and HH conceived and designed the study. RE, SE, and HH contributed to the literature search. OE, ED, RE, SE, HH, RT, SB, NE, AZ, and MA contributed to data collection. OE and SE contributed to data analysis. OE, SE, ED, RE, and RT contributed to data interpretation. RE, SE, HH, and RT contributed to writing the report. All authors contributed to revising the report. All authors read and approved the final version of the manuscript.

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### References

1. World Health Organization. 2021. Egypt: WHO coronavirus disease (COVID-19) dashboard. Accessed on: 24 February 2021. Available at: <https://covid19.who.int/region/emro/country/eg>
2. Mostafa A, Kandil S, El-Sayed MH, et al. Universal COVID-19 screening of 4040 healthcare workers in a



- resource-limited setting: an Egyptian pilot model in a university with 12 public hospitals and medical centers. *Int J Epidemiol.* 2021;50:50-61.  
<https://doi.org/10.1093/ije/dyaa173>
3. El-Sokkary RH, El-Kholy A, Mohy Eldin S, et al. Characteristics and predicting factors of Corona Virus Disease-2019 (COVID-19) among healthcare providers in a developing country. *PLoS One.* 2021;16:e0245672.  
<https://doi.org/10.1371/journal.pone.0245672>
4. Abdelmoniem R, Fouad R, Shawky S, et al. SARS-CoV-2 infection among asymptomatic healthcare workers of the emergency department in a tertiary care facility. *J Clin Virol.* 2021;134:104710.  
<https://doi.org/10.1016/j.jcv.2020.104710>
5. Mostafa A, Sabry W, Mostafa NS. COVID-19-related stigmatization among a sample of Egyptian healthcare workers. *PLoS One.* 2020;5:e0244172.  
<https://doi.org/10.1371/journal.pone.0244172>
6. Tartari E, Hopman J, Allegranzi B, et al. Perceived challenges of COVID-19 infection prevention and control preparedness: a multinational survey. *J Glob Antimicrob Resist.* 2020;22:779-81.  
<https://doi.org/10.1016/j.jgar.2020.07.002>
7. Bong CL, Brasher C, Chikumba E, McDougall R, Mellin-Olsen J, Enright A. The COVID-19 pandemic: effects on low- and middle-income countries. *Anesth Analg.* 2020;131:86-92.  
<https://doi.org/10.1213/ANE.0000000000004846>
8. Elhadi M, Msherghi A, Elgzairi M, et al. Assessment of the preparedness of obstetrics and gynecology healthcare systems during the COVID-19 pandemic in Libya. *Int J Gynaecol Obstet.* 2020;150:406-08.  
<https://doi.org/10.1002/ijgo.13273>
9. OpenEpi. 2013. Open Source Epidemiologic Statistics for Public Health, Version updated 06 April 2013. Accessed on: 26 February 2021. Available at: [www.OpenEpi.com](http://www.OpenEpi.com)
10. Centers for Disease Control and Prevention (CDC). 2020. Coronavirus Disease-2019 (COVID-19) 2020 Interim Case Definition, Approved April 5, 2020. Accessed on: 08 June 2020. Available at: <https://www.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/>.
11. World Health Organization. 2020. Perceptions of healthcare workers regarding local infection prevention and control procedures for COVID-19: research protocol. Accessed on: 15 August 2020. Available at: <https://www.who.int/publications/m/item/perceptions-of-healthcare-workers-regarding-local-infection-prevention-and-control-procedures-for-covid-19-research-protocol>
12. Hui-Chin Koo, Poh BK, Ruzita AT. Assessment of knowledge, attitude and practice towards whole grains among children aged 10 and 11 years in Kuala Lumpur, Malaysia. *Int J Food Sci Nutr Diet.* 2015;4:171-7/
13. Abbag HF, El-Mekki AA, Bshabshe AA, et al. Knowledge and attitude toward the Middle East respiratory syndrome coronavirus among healthcare personnel in the southern region of Saudi Arabia. *J Infect Public Health* 2018;11:720-2.  
<https://doi.org/10.1016/j.jiph.2018.02.001>
14. Abdel Wahed WY, Hefzy EM, Ahmed MI, Hamed NS. Assessment of knowledge, attitudes, and perception of health care workers regarding COVID-19, a cross-sectional study from Egypt. *J Community Health.* 2020;45:1242-51.  
<https://doi.org/10.1007/s10900-020-00882-0>
15. Olum R, Chekwech G, Wekha G, Nassozi DR, Bongomin F. Coronavirus disease-2019: knowledge, attitude, and practices of health care workers at Makerere University Teaching Hospitals, Uganda. *Front Public Health.* 2020;8:181.  
<https://doi.org/10.3389/fpubh.2020.00181>
16. Mehrotra S, Jambunathan P, Jindal M, Gupta A, Kapoor K. A cross-sectional survey to assess the knowledge regarding coronavirus disease (COVID-19) among health care professionals. *Med J Armed Forces India.* 2020.  
<https://doi.org/10.1016/j.mjafi.2020.07.001>
17. Malik UR, Atif N, Hashmi FK, et al. Knowledge, attitude, and practices of healthcare professionals on COVID-19 and risk assessment to prevent the epidemic spread: a multicenter cross-sectional study from Punjab, Pakistan. *Int J Environ Res Public Health.* 2020;17:6395.  
<https://doi.org/10.3390/ijerph17176395>
18. Temsah MH, Alhuzaimi AN, Alamro N, et al. Knowledge, attitudes and practices of healthcare workers during the early COVID-19 pandemic in a main, academic tertiary care centre in Saudi Arabia. *Epidemiol Infect.* 2020;148:e203.  
<https://doi.org/10.1017/S0950268820001958>
19. Grasselli G, Pesenti A, Cecconi M. Critical care usage for the COVID-19 outbreak in Lombardy, Italy: early experience and forecast during an emergency response. *JAMA* 2020;323:1545-6.  
<https://doi.org/10.1001/jama.2020.4031>
20. Lababidi HMS, Alzoraigi U, Almarshed AA, et al. Simulation-based training programme and preparedness testing for COVID-19 using system integration methodology. *BMJ Simul Technol Enhanc Learn.* 2021;7:126-33.  
<https://doi.org/10.1136/bmjstel-2020-000626>
21. Houghton C, Meskell P, Delaney H, et al. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. *Cochrane Database Syst Rev.* 2020;4:CD013582.  
<https://doi.org/10.1002/14651858.CD013582>
22. Carmassi C, Foghi C, Dell'Oste V, et al. PTSD symptoms in healthcare workers facing the three coronavirus outbreaks: what can we expect after the COVID-19 pandemic. *Psychiatry Res.* 2020;292:113312.  
<https://doi.org/10.1016/j.psychres.2020.113312>
23. Fell A, Beaudoin A, D'Heilly P, et al. SARS-CoV-2 exposure and infection among health care personnel -

- 
- Minnesota, March 6-July 11, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1605-10. <https://doi.org/10.15585/mmwr.mm6943a5>
24. World Health Organization. 2020. Social stigma associated with COVID-19. Accessed on: 06 June 2020.
- Available at: <https://www.who.int/docs/default-source/coronaviruse/covid19-stigma-guide.pdf>
25. Regenold N, Vindrola-Padros C. Gender matters: a gender analysis of healthcare workers' experiences during the first COVID-19 pandemic peak in England. Soc Sci. 2021;10:43. <https://doi.org/10.3390/socsci10020043>

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