

# Knowledge of COVID-19 and Its Treatment Among Healthcare Worker in Al-Ahsa Region of Saudi Arabia

Amal Khaleel Abu Alhommos, Bayan Ahmed AlSaad, Hebah Saleh AlRamadan, Inass Ahmed AlAlwan, Layla Saleh Butayban, Ruqaeya Abdullah AlHamad, Zainab Abdulathim AlSalman, EL Walid El Hassan

Pharmacy Practice Department, Clinical Pharmacy College, King Faisal University, Alhasa, Saudi Arabia

Correspondence: Amal Khaleel Abu Alhommos, Pharmacy Practice Department, Clinical Pharmacy College, King Faisal University, Alhasa, Saudi Arabia, Tel +966596150032, Email aabualhommos@kfu.edu.sa

**Objective:** To find out how well healthcare workers (HCWs) in Saudi Arabia's eastern region knew about the novel coronavirus illness 2019 (COVID-19) in terms of its symptoms, transmission, and treatment.

**Methods:** This is a cross-sectional study conducted in the Saudi Arabian region of Al-Ahsa. Between December 2020 and March 2021, a questionnaire was distributed in the main hospitals in the eastern region: King Fahad Hospital, Prince Saud Bin Jalawi Hospital, Prince Sultan Cardiac Center, and Maternity and Children's Hospital. Participants' knowledge of COVID-19 symptoms, transmission, and treatment was assessed using our developed questionnaire tool. The Student's *t*-test/ANOVA test was used to compare the mean knowledge scores of different demographic groups.

**Results:** A total of 300 HCWs participated in this study. Our study sample's mean knowledge score was 6.9 (SD = 2.1) out of 13 (53.1%), indicating a marginal degree of understanding. The duration of practice had a significant effect on the participants' knowledge of COVID-19. Senior and non-Saudi HCWs had a higher knowledge score than the rest of the groups ( $p \leq 0.05$ ). The majority of the participants were able to identify that COVID-19 is transmitted from human to human through respiratory droplets, populations at higher risk of developing severe complications, populations needing screening for COVID-19, main clinical symptoms of COVID-19, and were following the WHO guidelines for the treatment of COVID-19.

**Conclusion:** According to our findings, HCWs only had marginal knowledge about the symptoms, transmission, and treatment of COVID-19. As our findings represent early investigation at the start of the pandemic, more research is needed to evaluate the degree of information gathered two years after the outbreak began. Furthermore, future research should identify knowledge gaps in the targeted population of HCWs and provide strategies to address them.

**Keywords:** COVID-19, disease management, infectious disease transmission, Saudi Arabia, knowledge

## Introduction

COVID-19 (coronavirus disease 2019) is a respiratory tract infection caused by SARS-cov-2 (severe acute respiratory syndrome).<sup>1</sup> Person-to-person transmission of the SARS-cov-2 betacoronavirus pathogen causes the disease, which is thought to occur through close contact, most likely by respiratory droplets.<sup>2</sup> Despite the fact that middle-aged or older people account for the majority of the cases, infections in adolescents and children have also been reported.<sup>3</sup> In Saudi Arabia, a total of 796,268 confirmed cases were reported until July 02, 2022, with a total of 9211 deaths, with a recovery rate of 99.0% and a death rate of 1.0%.<sup>4</sup> In the United States, 94% of deaths occur in people over the age of 50 years, residents of nursing home, and patients with underlying medical conditions considered at high-risk.<sup>5,6</sup> In addition, children with medically complex diseases such as neurologic, metabolic, genetic, and cardiac conditions are at a higher risk.<sup>7</sup> A previous study by Lucki et al found that the COVID-19 pandemic has affected the operation of a non-COVID-19 hospital, causing a decrease in the number of hospitalizations, an increase in staff absences from work, and a decrease in the value of the revenue generated from health services provided.<sup>8</sup>

A previous multinational study that was conducted in Jordan, Saudi Arabia, and Kuwait has explored the knowledge and practices of the general public during the COVID-19 pandemic.<sup>11</sup> This study reported that the participants'

general knowledge of COVID-19 was moderate. The participants' knowledge of disease prevention and control was high, while questions about disease transmission patterns received the lowest sub-scale ratings.<sup>11</sup> Another study that was carried out in the western region of Saudi Arabia investigated the clinical characteristics of the disease and the knowledge of healthcare workers regarding COVID-19.<sup>12</sup> This study reported a good level of knowledge among the study participants regarding personal hygiene, information sources, and public health approaches to disease management.<sup>12</sup> A previous study in Ethiopia showed a moderate level of knowledge (66.5%) among the participating healthcare workers about COVID-19.<sup>13</sup> Another study in Saudi Arabia by Al-Hanawi et al reported a higher level of knowledge (81.6%) among the general public about COVID-19, with males being less knowledgeable compared to females.<sup>14</sup> Our study aimed at investigating the knowledge of healthcare workers regarding the new coronavirus disease 2019 (COVID-19), its symptoms, transmission characteristics, and treatment in several places in Saudi Arabia's Al-Ahsa region during the first year of the pandemic. While previous studies in Saudi Arabia focused on the clinical and psychological consequences of COVID-19 and COVID-19 vaccine acceptability,<sup>15–22</sup> few studies have investigated healthcare workers' knowledge of COVID-19, its symptoms, transmission, and treatment in the eastern region of Saudi Arabia.

## Methods

### Study Design and Settings

A cross-sectional survey was conducted to assess healthcare workers' knowledge of COVID-19 and its management between December 2020 and March 2021 in the main hospitals in the eastern region: King Fahad Hospital, Prince Saud Bin Jalawi Hospital, Prince Sultan Cardiac Center, and Maternity and Children's Hospital.

### Sampling Procedure

The study sample was gathered using a convenience sampling technique. This sampling procedure is a type of non-probability sampling. Eligible participants who meet our inclusion criteria and who are willing to participate in the study due to their availability were included in this study. An informed consent form was presented on the first page of the questionnaire, and participants were informed that they could proceed or leave at that time. The study objectives were stated clearly to make the participants aware of the significance of their involvement. The study inclusion criteria were mentioned in the invitation letter of the study.

### Study Population

We asked healthcare workers who worked at the participating hospitals throughout the pandemic to participate in the study. All practicing healthcare workers in the main hospitals in the eastern region: King Fahad Hospital, Prince Saud Bin Jalawi Hospital, Prince Sultan Cardiac Center, and Maternity and Children's Hospital formed the study population. There was no restriction on their profession, years of experience, or nationality.

### Study Tool

This research was based on a questionnaire that evaluated participants' knowledge of COVID-19 symptoms, transmission, and treatment. The questionnaire tool was developed based on the Saudi Ministry of Health's protocol for patients suspected of or confirmed with COVID-19.<sup>23</sup> The questionnaire also gathered information about respondents' socio-demographic characteristics, workplaces, and occupations. The knowledge section is comprised of 13 items in multiple choice question format. Each correct response is worth one point, while incorrect responses are worth zero. The higher the points, the more knowledgeable. As the knowledge section was comprised of 13 questions, the maximum obtainable score is expected to be 13.

### Piloting of the Questionnaire Tool

Clinical pharmacists from King Faisal University's College of Clinical Pharmacy reviewed and validated the questionnaire tool. They were questioned about the clarity and comprehensibility of the questions, as well as their face validity.

and whether any of the questions were difficult to understand. They were also asked if any of the questions offended or bothered them. They said the questionnaire was simple to understand and fill out. Furthermore, before implementing the questionnaire on a larger scale, a pilot study with a small number of participants was conducted to assess comprehension, and they confirmed that it is clear and straightforward.

## Ethical Approval

The research ethics committee at the Ministry of Health, Al-Ahsa, Saudi Arabia, approved the study protocol (RS-201035). Informed consent was obtained from the study participants prior to study commencement. This study was conducted in accordance with the World Medical Association (WMA) Declaration of Helsinki.

## Sample Size

The minimum required sample size was 385 individuals using a 95% confidence interval, a 0.5 standard deviation (SD), and a 5% margin of error.

## Statistical Analysis

The demographic characteristics of the participating individuals were described using descriptive statistics. The continuous variable's normality was examined using the histogram and normality measures, which proved that the data was normally distributed. Based on that, continuous variables, including the participants' knowledge score, were presented using the mean (standard deviation (SD)). Percentages were used to report categorical data (frequencies). The mean knowledge scores of different demographic groups were compared using the Student's *t*-test/ANOVA test. Statistical significance was defined as two-sided  $p < 0.05$ . Statistical Package for Social Science software (SPSS) was used to conduct the statistical analysis (version 27).

## Results

### Characteristics of the Study Sample

A total of 300 healthcare workers participated in this study, of which around 85.0% were aged 21–40 years. More than half (59.7%) were females, and the vast majority (79.0%) were Saudis. Around half of them (49.3%) were nurses. A total of 40.0% of them were working at King Fahad Hospital, and 38.0% of them had work experience of less than six years. One-third of the study participants (33.7%) reported that they volunteered on the COVID-19 medical providers team. Refer to [Table 1](#) for further details on the characteristics of the study sample.

### Knowledge of COVID-19 Transmission Characteristics

#### General Knowledge

[Table 2](#) below highlights participants' knowledge of COVID-19 transmission and treatment. Around half of the study participants (57.0%) were able to identify the reason behind naming COVID-19 as the coronavirus disease. A majority of the participants (73.7%) were able to identify the main transmission source of the first cases of COVID-19 presented in Wuhan, China. The vast majority (91.7%) of the participants were able to identify that COVID-19 is transmitted from human to human through respiratory droplets.

#### Knowledge About Disease Prognosis and Prevention

Around 87.0% of participants were able to identify the populations most likely to have a severe case of COVID-19, which included individuals with chronic disease, obese patients, and the elderly. Most of the participants were able to identify three populations that need screening for COVID-19: those with close contact with confirmed COVID-19 cases, those coming from countries that have a high incidence of COVID-19 cases, and those having some of the main clinical symptoms of COVID-19. The majority of participants (84.0%) were able to name the PCR test as the primary method for verifying the diagnosis of COVID-19. The vast majority of the participants (89.7%) were able to identify the main clinical symptoms of COVID-19, which are fever  $\geq 40^\circ\text{C}$ , shortness of breath, and dry cough.

**Table I** Participants' Demographic Characteristics

Demographic Variable	Frequency (%)
<b>Age category</b>	
21–30 years	131 (43.7)
31–40 years	127 (42.3)
41–59 years	39 (13.0)
60 years and above	3 (1.0)
<b>Gender</b>	
Female	179 (59.7)
<b>Nationality</b>	
Saudi	237 (79.0)
<b>Occupational status</b>	
Nurse	148 (49.3)
Technical staff	70 (23.3)
Specialist physician	40 (13.3)
Consultant physician	20 (6.7)
Hospital Pharmacist	9 (3.0)
Clinical Pharmacist	8 (2.7)
General practitioner	5 (1.7)
<b>Workplace</b>	
King Fahad Hospital	120 (40.0)
Prince Saud Bin-Jalawi Hospital	68 (22.7)
Maternity and Children Hospital	78 (26.0)
Prince Sultan Cardiac Centre	25 (8.3)
Others	9 (3.0)
<b>Duration of practice</b>	
Less than 6 years	114 (38.0)
6–10 years	91 (30.3)
11–15 years	62 (20.7)
16–20 years	16 (5.3)
21 years and above	17 (5.7)
<b>Volunteer in COVID-19 medical providers team?</b>	
Yes	101 (33.7)

### Knowledge About Disease Management

Following confirmation of a mild to moderate COVID-19 case (no oxygen requirement and no evidence of pneumonia), a small proportion of participants (11.0%) were able to identify that the proper treatment should include Favipiravir or

**Table 2** Participants' Knowledge About COVID-19

Variable	Frequency (%)
Why COVID-19 called as coronavirus?	
It means, highly transmission	52 (17.3)
It has a crown shape	171 (57.0)
Transmitted from a city in China	31 (10.3)
I do not know	46 (15.3)
What is the main transmission source of first cases of COVID-19 presented in Wuhan/ china?	
Bat	221 (73.7)
Camel	21 (7.0)
Snake	18 (6.0)
Mouse	11 (3.7)
I do not know	29 (9.7)
How COVID-19 transmitted from human to human?	
Faeces	2 (0.7)
Blood	1 (0.3)
Skin touch	10 (3.3)
Respiratory droplets	275 (91.7)
I do not know	12 (4.0)
Which one of following population are the most likely to develop a severe case of COVID-19?	
Chronic disease, obesity, and elderly	262 (87.3)
Pregnant, strong family history for coronary artery disease	17 (5.7)
Adolescent, diabetic patients	2 (0.7)
Seasonal rhinitis, adolescent, normal BMI	4 (1.3)
I do not know	15 (5.0)
Which population needs screening for COVID-19 (you can choose more than one option)?	
A close contact with confirmed COVID-19 cases	216 (72.0)
Person comes from country that have high incidence of COVID-19 cases	65 (21.7)
Patient having some of the main clinical symptoms of COVID-19	198 (66.0)
Patient having chronic diseases	45 (15.0)
Geriatric people	23 (7.7)
I do not know	13 (4.3)
How to confirm the diagnosis of COVID-19?	
By symptoms	28 (9.3)
PCR	251 (83.7)

(Continued)

**Table 2** (Continued).

Variable	Frequency (%)
Patient history	1 (0.3)
CBC	4 (1.3)
I do not know	16 (5.3)
What are the main clinical symptoms of COVID-19?	
Fever $\geq 40$ , shortness of breath, and dry cough	269 (89.7)
Fever $\geq 40$ , myalgia, diarrhea	6 (2.0)
Fever $\geq 40$ , rhinorrhea, headache	9 (3.0)
I do not know	16 (5.3)
After confirming diagnosis of mild to moderate COVID-19 case (no oxygen requirement, no evidence of pneumonia), what is the treatment usually given to them (you can choose more than one option)?	
Azithromycin, ceftriaxone	108 (36.0)
Favipiravir or Remdesivir	33 (11.0)
Supportive therapy (Vitamin C, Vitamin D, Zinc, antipyretic)	217 (72.3)
Dexamethasone	51 (17.0)
Hydroxychloroquine	40 (13.3)
VTE prophylaxis	18 (6.0)
None of the above	21 (7.0)
After confirming diagnosis of severe non-critical COVID-19 (Respiratory rate $\geq 30$ /rbm (adults), Blood oxygen saturation $\leq 93\%$ , or $\text{PaO}_2/\text{FiO}_2$ ratio 50% of the lung field within 24–48 hours) What is the treatment usually given to them? (you can choose more than one answer)?	
Azithromycin, ceftriaxone	117 (39.0)
Favipiravir or Remdesivir	79 (26.3)
Supportive therapy (Oxygen supplement, Fluids replacement, Zinc, Vitamin C, Vitamin D, antipyretic)	195 (65.0)
Dexamethasone	97 (32.3)
Hydroxychloroquine	55 (18.3)
VTE prophylaxis	39 (13.0)
None of the above	15 (5.0)
In patients with severe critical COVID-19 (Symptoms $\geq 1$ of the following: ARDS, Sepsis, altered consciousness, or Multi-organ failure), What is/are the treatment usually given to them? (you can choose more than one answer)?	
Azithromycin, ceftriaxone	144 (48.0)
Favipiravir or Remdesivir	217 (72.3)
Supportive therapy (Oxygen supplement, Fluids replacement, Zinc, Vitamin C, Vitamin D, antipyretic)	300 (100)
Dexamethasone	231 (77.0)
Hydroxychloroquine	92 (30.7)

(Continued)

**Table 2** (Continued).

Variable	Frequency (%)
VTE prophylaxis	80 (26.7)
None of the above	13 (4.3)
Which guidelines you follow in the treatment of COVID-19? (you can choose more than one answer)	
WHO	209 (69.7)
NIH	27 (9.0)
CDC	52 (17.3)
IDSA	30 (10.0)
I do not know	55 (18.3)
In patient with cytokine release syndrome and COVID-19 which treatments is more indicated?	
Tocilizumab	136 (45.3)
Saritumab	17 (5.7)
Canakinumab	33 (11.0)
Dupilumab	21 (7.0)
Siltuximab	16 (5.3)
If vaccine exists, which population will be vaccinated?	
Adult without comorbid disease	64 (21.3)
High risk patient of severe cases of COVID-19	211 (70.3)
Pediatrics	1 (0.3)
Pregnant	3 (1.0)
I do not know	26 (8.7)

Remdesivir, and 72.3% were able to identify that supportive therapy (Vitamin C, Vitamin D, Zinc, and antipyretics) is an important part of the management plan.

After confirming the diagnosis of severe non-critical COVID-19 (respiratory rate  $\geq 30$ /breath per minute (bpm) (adults), blood oxygen saturation  $\leq 93\%$ , or partial pressure of oxygen (PaO<sub>2</sub>)/ fraction of inspired oxygen (FiO<sub>2</sub>) ratio of 50% of the lung field within 24–48 hours), a small proportion of the participants were able to identify that the proper treatment should contain Favipiravir or Remdesivir (26.3%), and dexamethasone (32.3%), and 65.0% were able to identify that supportive therapy (oxygen supplement, fluid replacement, Zinc, Vitamin C, Vitamin D, and antipyretic) is an essential part of the management plan.

In patients with severe critical COVID-19 (symptoms  $\geq 1$  of the following: acute respiratory distress syndrome (ARDS), sepsis, altered consciousness, or multi-organ failure), the majority of the participants were able to identify that the proper treatment should contain Favipiravir or Remdesivir (72.3%) and dexamethasone (77.0%), and 100% were able to identify that supportive therapy (oxygen supplement, fluid replacement, Zinc, Vitamin C, Vitamin D, and antipyretics) is an essential part of the management plan.

The majority of the participants (69.7%) reported that they follow the World Health Organization (WHO) guidelines for the treatment of COVID-19 patients. Less than half of the participants (45.3%) were able to identify that Tocilizumab

**Table 3** Mean Knowledge Score Stratified by Demographic Characteristics

Demographic Variable	Mean Knowledge Score (Standard Deviation)	P-value
Age category		
21–30 years	6.9 (2.0)	0.136
31–40 years	6.7 (2.2)	
41–59 years	7.5 (2.2)	
60 years and above	8.0 (0.0)	
Gender		
Female	6.7 (2.3)	0.141
Male	7.1 (1.9)	
Nationality		
Saudi	6.7 (2.1)	0.000**
Non-Saudi	8.1 (1.8)	
Duration of practice		
Less than 6 years	6.9 (2.1)	0.026*
6–10 years	6.5 (2.1)	
11–15 years	7.0 (2.0)	
16–20 years	7.8 (2.2)	
21 years and above	8.0 (2.2)	

Note: \* $p \leq 0.05$ , \*\* $p \leq 0.001$ .

is indicated in patients with cytokine release syndrome and COVID-19. Additionally, 70.3% of the participants were able to identify that high-risk patients with severe cases of COVID-19 should be given priority for vaccination.

## Predictors of Better COVID-19 Knowledge

The mean knowledge score of our study sample was 6.9 (SD=2.1) out of 13 (53.1%), representing a marginal level of knowledge. There was no statistically significant difference in the mean knowledge score between different age groups or males and females with ( $p=0.136$ ) and ( $p=0.141$ ), respectively. On the other hand, duration of practice and nationality affected the mean knowledge score significantly; where senior healthcare workers and non-Saudis showed higher knowledge scores compared to others ( $p \leq 0.05$ ). Table 3 below presents the mean knowledge score stratified by demographic characteristics.

## Discussion

The key findings of our study are: 1) the vast majority of the participants were able to identify that COVID-19 is transmitted from human to human through respiratory droplets, 2) the majority of the participants were able to identify which populations are the most likely to develop a severe case of COVID-19, 3) most of the participants were able to identify which populations need screening for COVID-19, 4) the vast majority of the participants were able to identify the main clinical symptoms of COVID-19, 5) the majority of participants said they follow the WHO guidelines for treating COVID-19 patients, 6) more than half of the participants were able to identify that high-risk patients with severe cases of COVID-19 should be given priority for vaccination, 7) our study participants had a marginal level of knowledge



about COVID-19, and 8) the duration of practice had a significant effect on the mean knowledge score, with senior healthcare workers and non-Saudis having a higher knowledge score than others.

COVID-19 is relatively a new virus disease that affects a large number of patients worldwide, as a result, this increased the global emergency to treat this virus.<sup>1</sup> It also affects the social relationships and mental wellbeing of all sectors of the community.<sup>24–28</sup> That is why it is important to assess the knowledge of the frontline healthcare workers,<sup>2</sup> about this disease, such as how it is transmitted, the main clinical symptoms, and how to treat moderate to severe cases. The effectiveness of the treatment will increase as more knowledge about the disease and its management is acquired.

This survey revealed that different healthcare workers in the Al-Ahsa region had sufficient knowledge about COVID-19 transmission, such as respiratory droplets from one patient to another. Furthermore, the vast majority of our healthcare workers were able to recognize the most common clinical symptoms, including fever, shortness of breath, and dry cough. These findings are consistent with earlier research. One of them used a web survey in Pakistan,<sup>3</sup> and the other was conducted in a hospital in Ho Chi Minh City, Vietnam's south-eastern area.<sup>5</sup> In one Iranian study conducted<sup>29</sup> in Kermanshah, healthcare workers demonstrated that 99% of them had appropriate knowledge of COVID-19 transmission. However, just 86% of people are aware of the disease's symptoms.<sup>7</sup> In Jordan, a survey of dentists found comparable results in terms of transmission method.<sup>6</sup> A study by Alrajhi et al in Makkah city, Saudi Arabia reported that 82.0% of the participants showed a high level of knowledge about the disease transmission with a similar proportion (82.5%) being highly knowledgeable about precautionary measures.<sup>30</sup> Another study by AlRasheed et al in Saudi Arabia reported good knowledge about COVID-19 among pharmacists with no significant difference between them and other healthcare professionals.<sup>31</sup> Another study by Al-Dossary R. et al in Saudi Arabia reported that the majority of nurses (96.9%) had excellent knowledge of COVID-19. Some (83.2%) of nurses reported significant prevention knowledge and treatment skills about COVID-19, while 7.6% had little knowledge about prevention.<sup>32</sup> Compared to other populations of interest, a previous study in a sample of elderly Italian people found a satisfactory level of knowledge about COVID-19 and the related control measures,<sup>33</sup> which confirms the findings of other studies from different countries.<sup>34–36</sup> A previous study in Ethiopia found that healthcare workers had a moderate level of knowledge (66.5%) about COVID-19.<sup>13</sup> There are multiple reasons for the differences in the level of knowledge across HCWs in different countries. These include the timing of the survey, the difference in study populations (different healthcare professions and years of experience), and different assessment tools. Another important cause of variation is the source of information, where previous studies in Vietnam, India, and Ethiopia reported that the main source of information was social media platforms,<sup>5,13,37</sup> which was different from that in Middle Eastern countries such as Egypt and Saudi Arabia, which relied on the WHO and other local healthcare authorities.<sup>38,39</sup>

According to the Centers for Disease Control and Prevention (CDC), the COVID-19 can be transmitted in a variety of ways, including inhaling the virus, which travels through the air as fine droplets.<sup>9</sup> Once the patient is within three to six feet of the infection source, he or she will catch the infection in his or her respiratory fluid. The deposition of these viral small droplets onto the mucous membrane is another method. The third technique is to spread the disease to your mucous membrane by touching a contaminated surface with your hand. People try to reduce COVID-19 inhalation and deposition to prevent the virus from spreading.<sup>9</sup> People must maintain a social distance from others, use a face mask, maintain proper ventilation, and avoid crowding inside. In addition, they must practice good hand hygiene to minimize the spread of infection from touching a contaminated surface (7). In comparison to a previous study conducted in the United Arab Emirate,<sup>37</sup> where only (39%) of healthcare workers were able to identify the cause of COVID-19 transmission and 73% were able to recognize the main clinical symptoms, our study findings indicated a higher level of knowledge regarding disease transmission. One reason for the disparity is that this research was conducted in 2019. Besides, in comparison to our understanding today, not all healthcare workers from had an adequate understanding of COVID-19 at the time.

Some people are more prone than others to be affected by COVID-19. The elderly population, for example, has lowered immunity. Moreover, patients with comorbidities such as diabetes, hypertension, obesity, and chronic kidney disease are more likely to develop severe disease, require hospitalization, and die. These patients' immune systems are overreacting and secreting proinflammatory cytokines.<sup>40–42</sup> The majority of the healthcare workers who took part in this study were able to identify the populations that are most likely to have a severe case of COVID-19. Patients with chronic

diseases, the elderly, and the obese were among them. A cross-sectional web survey in China and another study in Egypt yielded comparable results.<sup>39,43</sup>

For COVID-19 treatment, the majority of our healthcare workers followed WHO standards. In comparison to a prior study, this one relies more on the media for treatment.<sup>3</sup> This pandemic disease necessitates a more trustworthy and objective source. In February 2020, the World Health Organization (WHO) warned that the pandemic had been accompanied by a flood of false and misleading information.<sup>44,45</sup> Furthermore, WHO advised people to obtain trusted sources of information.<sup>45</sup> Although information in the media spreads swiftly, it may contain inaccurate information. False health information widely disseminated on social media has a significant influence on people's lives.<sup>10</sup>

The majority of healthcare workers in our study were able to identify populations that needed COVID-19 screening. People who have had close contact with an infected patient, people who come from a country where COVID-19 cases are common, and patients who have some of COVID-19's key clinical signs. In a recent study conducted in Saudi Arabia, more than 98% of healthcare workers recommended a 14-day quarantine period for anyone who had direct contact with an infected patient.<sup>14</sup> COVID-19 has an impact on the respiratory system, causing pneumonia, as well as the gastrointestinal and neurological systems.<sup>29</sup> As a result, early diagnosis of the disease is critical in reducing these symptoms and avoiding hospitalization. Furthermore, the most crucial goal of COVID-19 intervention is to prevent disease transmission. As a result, screening patients and anyone in close contact with them for COVID-19 is highly advised.<sup>29</sup>

The results of this survey revealed that different healthcare workers have a marginal level of knowledge about symptoms, transmission, and treatment of COVID-19. The knowledge score did not differ significantly across different age groups and between males and females. This observation is consistent with earlier findings.<sup>3,5,14,46,47</sup> In a study conducted by Saqlain et al, they found that pharmacists had greater COVID-19 practice and knowledge than other healthcare workers.<sup>3</sup> However, in another study conducted in Egypt, they found that doctors had the highest level of knowledge, followed by pharmacists, and nurses.<sup>39</sup> In our study, seniors showed higher level of knowledge compared to others. The fact that seniors have been practicing for longer than other healthcare workers may explain why they scored higher on knowledge in this survey. Despite that, other studies found the opposite.<sup>3,5</sup>

All healthcare workers benefit from increased awareness and current information about COVID-19 prevention, transmission, and treatment. According to a previous study, healthcare workers having prior experience with SARS and Middle East respiratory syndrome (MERS) disease had considerably higher awareness scores than healthcare workers without prior experience.<sup>29</sup> Furthermore, countries that had previously experienced similar outbreaks like SARS, such as Hong Kong, Vietnam, and Taiwan, were able to successfully deal with COVID-19 in the early stages of the pandemic, compared to countries that had no prior expertise.<sup>29</sup> Based on our findings, we recommend that all healthcare workers have their awareness raised on a regular basis using a credible source of information such as WHO and CDC checklists. Because COVID-19 knowledge is linked to positive attitudes and proper COVID-19 practices,<sup>11</sup> governments should develop targeted information campaigns that inform all healthcare workers about the most up-to-date evidence and practices. This should include training programs and educational interventions on infection control practices for COVID-19 across all healthcare workers. Educational training should be provided on a regular basis to update all healthcare workers on best health care practices and the most updated guidelines. Future studies should develop such interventions and explore their effectiveness across different healthcare professionals.

This research has certain drawbacks. Convenience sampling may have altered the generalizability of our findings. As a result, when the data was collected, certain demographic groups may have been missing. This is clear considering that the majority of our study participants were under the age of 40 years and were nurses. We tested our newly constructed (non-standardized) questionnaire instrument on a small group of participants without any further validation methods, which is a serious and irreversible limitation. The study design itself, a cross-sectional survey design, limited our ability to identify causality between study variables. There are limited studies that have assessed knowledge of healthcare workers during the COVID-19 pandemic using similar survey tools, as different studies used different tools to explore participants' knowledge, which limited our ability to compare our findings. In this study, we employed a quantitative methodology with pre-set responses, which might not have allowed participants' views to provide varied but useful qualitative information. Unfortunately, the number of participants did not reach the minimum required sample size, and we were unable to determine

the response rate since we did not estimate the number of individuals that were asked to participate in the study. This may increase the likelihood of non-response bias. As a result, our findings must be interpreted carefully.

## Conclusion

According to our study findings, healthcare workers had only a marginal level of knowledge about the symptoms, transmission, and treatment of COVID-19. The duration of practice had a significant effect on the participants' knowledge about COVID-19. Senior healthcare workers and non-Saudis showed a higher level of knowledge of COVID-19. Further research is needed to investigate the level of knowledge gained two years after the epidemic began, as our findings represent early investigation at the outset of the pandemic. Furthermore, future studies should identify knowledge gaps and provide strategies to fill them within the targeted community of healthcare workers.

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## Disclosure

The authors declare no conflicts of interest.

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