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## Clinical Characteristics and Risk Factors for COVID-19 among Health Care Workers in Saudi Arabia: A Cross-Sectional Study.

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### Abstract

**Objectives:** The study explores the main health care workers (HCWs) clinical characteristics and related behaviors with procedures that impose risk of acquiring COVID-19 infection.

**Method:** This was a cross-sectional study conducted at East Jeddah Hospital. 100 Health Care worker participants who were detected as COVID-19 cases from March to July 2020 was obtained from the infection control department, and these HCWs were asked to fill out a questionnaire designed for this study. Data was analyzed using SPSS, and categorical data presented as counts and proportions.

**Results:** Among the 100 HCWs who contracted COVID-19, there was a marked predominance of females (69.0%) over males (31.0%). When dealing with COVID-19 cases, 93.1% of HCWs reported wearing a surgical mask and 61% an N95 mask, while only 69–80% reported wearing gloves, a disposable gown and eye protection. The procedures found to increase the risk of infection were taking nasopharyngeal swabs (23.0%), inserting nasogastric tubes (22.0%), ventilation (17.0%), and tracheal intubation (14.0%).

**Conclusion:** This study confirms that noncompliance with the use of PPE as well as performing a specific procedure and working in close contact (<1.5 meters) for longer than 20 minutes increased the risk of infection. No minimal protective measures against SARS-CoV-2 infection.

**Recommendation:** Analysis of the data obtained in this study demonstrates the significant of using personal protective equipment's effectively among health care workers and its vital role in reducing rate of infection transmission. However, further cohort study required in the same field to obtain a comprehensive outcomes.

**Keywords:** *COVID-19, East Jeddah Hospital, Health care workers, Saudi Arabia, Personal protective equipment's*

## Introduction

Since its outbreak in December 2019 in Wuhan, China, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes coronavirus disease 2019 (COVID-19) has been extensively studied to understand its mode of transmission and pathogenesis. One of the most important factors in controlling the COVID-19 pandemic is an understanding of the mode of transmission, not only within the community, but also in hospitals, otherwise hospitals will be a source of infection.

Debate is ongoing on regarding the time and duration of the infectious phase in pre-symptomatic cases and whether asymptomatic carriers can transmit the infection or not. Knowing the answers to these questions will help maintain infection control in hospitals, especially when considering that most frontline health care workers (HCWs) can be asymptomatic carriers and thus may transmit infection to their close contacts in the hospital or the wider community.

Asymptomatic carriers have been documented in studies of family clusters. In a study of a family cluster who traveled to Wuhan during the outbreak, the presence of asymptomatic carriers of SARS-CoV-2 was confirmed by positive virological and radiological investigation.<sup>1</sup> Also, studying viral load showed that symptomatic and asymptomatic cases shared the same viral load, indicating that they have the same theoretical potential to transmit infection.<sup>2</sup> However, in July 2020, based on detailed cluster investigations and contact tracing activities from different countries, the World Health Organization announced that asymptomatic carriers are less likely to transmit infection.<sup>3</sup> This announcement has affected decision-making and policies in hospitals in many countries.

In Saudi Arabia, the first version of the protocol for management of HCWs after exposure to COVID-19 was released in February, and classified management of health care workers based on the risk of exposure into two categories. The first category is (unprotected low risk exposure= more than 1.5 meter or asymptomatic protected HCW) and in this situation, swabbing not recommended and health care personnel's can continue their duties. However, the second category is (unprotected high risk exposure= within 1.5 meter or have suggestive symptoms regardless of the exposure type and in this case the HCW must stop their duties and swabbing is required). Additionally, on April 2020, further protocol for management of HCWs initiated and it stated that those who were classified as being in the high exposure category (prolonged close contact with a symptomatic confirmed COVID-19 patient not wearing a mask, defined as a distance of less than 1.5 meters for more than 20 minutes with the HCW not wearing a mask or respirator) should be excluded from work for 14 days after exposure.

Those who were classified as at medium risk (prolonged close contact with asymptomatic cases or symptomatic cases wearing a mask, with the HCW not wearing a mask or respirator) were to be excluded until they returned a negative COVID-19 test. The HCW was to be considered clear of infection and able to return to work if asymptomatic for at least 48 hours, the 14-day observation period was over, and the worker had returned at least two negative RT-PCR tests for COVID-19. An update to this protocol was released in May, and announced that the same protocol of the last version on April except on the high risk category it's preferable to perform swab 3 to 5 days post exposure and exclude from work for 14 days from the last exposure. . The latest update, in June, stated that if the exposure risk category was high or low, the HCW should continue in their duties and use universal personal protective equipment (PPE) as long as they were asymptomatic. However, if they developed symptoms they should refrain from clinical duties and report to the infection control department immediately.

HCWs, especially those working providing care to COVID-19 patients, are at high risk of infection. It was reported that as of 24 February 2020, just two months after the beginning of the outbreak in

China, 3,387 of 77,262 patients were HCWs or those who worked in medical facilities, an overall proportion of 4.4% of cases, and that 23 HCWs had died by 3 April.<sup>4</sup> By March, 42,600 HCWs had been sent to Hubei Province, where the outbreak began, to care for COVID-19 patients. Interestingly, none of these 42,600 workers were reported as having been infected, suggesting that following strict precautions may be sufficient to prevent SARS-CoV-2 infection.<sup>4</sup> Another cross-sectional study was conducted on 420 HCWs who had been deployed to Wuhan for 6–8 weeks, during which time all were provided with appropriate PPE while working. The authors reported that none of these HCWs experienced symptoms or tested positive for IgM/IgG antibodies against SARS-CoV-2 in their serum samples,<sup>5</sup> again indicating that despite being at high risk, appropriate use of PPE may be sufficient protect against COVID-19.

According to a study published in the *Journal of Hospital Infections*, there were three reasons for HCWs being infected at the beginning of the outbreak in China.<sup>6</sup> The first was not using effective personal protection, since HCWs did not yet understand the pathogen very well at that stage of the outbreak. The second was an increased risk of infection due to long exposure periods and to large numbers of cases. Thirdly, and most importantly, there was a shortage of adequate PPE as a result of increased demand.

The studies available on COVID-19 indicate that there are gaps in the research into this illness, and in particular, when it comes to how COVID-19 affects HCWs. To the best of available knowledge, no studies have been conducted in Saudi Arabia to describe the clinical characteristics or risk factors for COVID-19 among HCWs. The study aimed to determine which HCWs are at risk, describe their clinical characteristics, study their clinical practices, and investigate whether the protective measures they applied were sufficient to protect against infection.

## **Material and Methods**

The study used a descriptive cross-sectional approach and was conducted at East Jeddah Hospital. A list of one hundred HCWs who had been infected with SARS-CoV-2 was obtained from the infection control department, and these workers were contacted and asked to fill out the study questionnaire. The inclusion criteria were all HCWs who were COVID-19 positive during the study period, from March to July 2020 and agreed to participate. HCWs who did not work at the hospital during the study period were excluded.

The primary aim was to describe the clinical characteristics of HCWs who were at risk of COVID-19. Secondary aims were to evaluate whether the PPE provided to HCWs was adequate in protecting against COVID-19; to define the minimal protective measures that may prevent infection; and to understand the clinical practices and behaviors that increase HCWs' risk of infection with SARS-CoV-2 in Saudi hospitals.

Data was collected using a questionnaire designed for this study. The form was divided into demographic information, medical history, clinical procedures HCWs employed, their clinical practices and frequency of using PPE in general, and specifically when providing care to COVID-19 patients, as well as details of their exposure duration, distance, and clinical procedures and practices, if known. The data were analyzed using SPSS version 24. Categorical data were described as counts and proportions.

## **Results**

One hundred HCWs working in a government hospital who had been contracted COVID-19 were asked to fill out a questionnaire describing the clinical picture of their illness, and their adherence to instructions regarding the use of protective measures against COVID-19. This section describes the demographic characteristics of the participants and the clinical picture of their illness; their

adherence to the recommended preventive measures, and the potential mode and sources of infection among HCWs.

### ***Characteristics of the health worker cases***

There was a marked predominance of females (69.0%) over males (31.0%), with most HCWs being Saudis (77.0%). Their mean age was  $31.7 \pm 7.7$  years; with middle-aged workers (30–40 years) representing almost half the cases (47.0%). Slightly less than one-third (29.0%) indicated that they were current smokers. Five cases (5.0%) reported that they were asthmatic, three (3.0%) were hypertensive, and one case was diabetic (Table 1).

**Table 1: HCW characteristics (n=100)**

<b>Characteristics</b>	<b>No.</b>	<b>Percentage</b>
<b><i>Gender</i></b>		
Male	31	31.0
Female	69	69.0
<b><i>Nationality</i></b>		
Saudi	77	77.0
Non-Saudi	23	23.0
<b><i>Age categories</i></b>		
<30 years	43	43.0
30≤40 years	47	47.0
≥40 years	10	10.0
<b><i>Smoking status</i></b>		
Smoker	29	29.0
Non-smoker	71	71.0
<b><i>Chronic diseases</i></b>		
Diabetes mellitus	1	1.0
Hypertension	3	3.0
Bronchial asthma	5	5.0

Fever was the commonest symptom reported (57.0%), followed by cough (53.0%) and headache (43.0%). Almost one-third of the cases (33.0%) reported fatigue, and 32.0% had loss of taste and smell. Lesser percentages cases experienced sore throat (27.0%), diarrhea (23.0%), runny nose (18.0%), and shortness of breath (12.0%). Two-thirds of cases (67.0%) were isolated at home, while 27.0% were referred to quarantine hotels, and 6.0% required isolation in isolation rooms in hospital (Table 2).

**Table 2: Clinical picture and care provided to HCWs with COVID-19**

<b>Signs and symptoms/treatment</b>	<b>No.</b>	<b>Percentage</b>
<b><i>Signs and symptoms</i></b>		
Fever	57	57.0
Cough	53	53.0
Headache	43	43.0
Fatigue	33	33.0
Loss of taste	32	32.0
Loss of smell	32	32.0
Sore throat	27	27.0
Diarrhea	23	23.0
Runny nose	18	18.0

Shortness of breath	12	12.0
Vomiting	11	11.0
Chest pain	8	8.0
Dizziness	5	5.0
Myalgia	4	4.0
Abdominal pain	4	4.0
Anorexia	3	3.0
Confusion	1	1.0
Conjunctivitis	1	1.0
Skin rash	1	1.0
<b>Place of isolation</b>		
Isolation room in a hospital	6	6.0
Referred to quarantine	27	27.0
Home isolation	67	67.0

**Adherence of the HCWs to the instructions regarding PPE and preventive measures**

The overwhelming majority of the cases (93.7%) reported that they always wore surgical masks when dealing with non-COVID-19 cases in the hospital, while 29.8% always wore gloves. Only 9.3% reported wearing disposable gowns, while 6.3% wore N95 masks. When dealing with COVID-19 cases, a much higher percentage of the HCW cases (61.1%) reported always wearing N95 masks, 80% always wore disposable gowns, 83.3% always wore gloves, and 69.0% wore eye protection (Table 3).

**Table 3: HCW compliance with PPE use**

Type of PPE	None n (%)	Rare n (%)	Sometimes n (%)	Mostly n (%)	Always n (%)
<b>Wearing PPE while dealing with non-COVID-19 cases</b>					
N95 mask (n=80)	58 (72.5)	3 (3.8)	9 (11.3)	5 (6.3)	5 (6.3)
Surgical mask (n=95)	1 (1.1)	0 (0.0)	4 (4.2)	1 (1.1)	89 (93.7)
Disposable gown (n=86)	44 (51.2)	7 (8.1)	18 (20.9)	8 (9.3)	8 (9.3)
Gloves (n=84)	40 (47.6)	2 (2.4)	8 (9.5)	9 (10.7)	25 (29.8)
Eye protection (n=72)	53 (73.6)	3 (4.2)	9 (12.5)	5 (6.9)	2 (2.8)
<b>Wearing PPE while dealing with COVID-19 cases</b>					
N95 mask (n=90)	15 (16.7)	0 (0.0)	11 (12.2)	9 (10.0)	55 (61.1)
Surgical mask (n=86)	3 (3.3)	1 (1.1)	1 (1.1)	1 (1.1)	85 (93.5)
Disposable gown (n=95)	5 (5.3)	1 (1.1)	5 (5.3)	8 (8.4)	76 (80.0)
Gloves (n=96)	4 (4.2)	1 (1.0)	5 (5.2)	6 (6.3)	80 (83.3)
Eye protection	11 (13.1)	2 (2.4)	7 (8.3)	6 (7.1)	58 (69.0)

**Potential sources and modes of infection**

Almost two-thirds of the HCW cases (60.7%) stated that they had been involved in the care of confirmed COVID-19 cases before being infected, while 39.3% reported caring for suspected cases. Their involvement included taking nasopharyngeal swabs (23.0%), introducing nasogastric tubes (22.0%), providing ventilation (17.0%), and tracheal intubation (14.0%). More than one-half of cases they cared for (54.5%) were symptomatic and wearing masks, while 27.3% were asymptomatic but wearing masks. Only two HCW cases cared for unmasked symptomatic patients, while another two HCWs had treated unmasked asymptomatic COVID-19 patients. Two-thirds of

the HCW cases pointed that they had come into contact with COVID-19 patients for at least 20 minutes (60.9%), at a distance of less than 1.5 meters in the great majority of the cases (Table 4).

**Table 4: Possible sources and modes of infection**

Sources and modes of infection	No.	Percentage
<b><i>Involvement in procedures for COVID-19 cases</i></b>		
Tracheal intubation	14	14.0
Ventilation	17	17.0
Nasogastric tube	22	22.0
Sputum aspiration	12	12.0
Tracheostomy care	2	2.0
Oral care	10	10.0
Nasopharyngeal swab	23	23.0
Aerosol inhalation	7	7.0
<b><i>Type of COVID-19 patients cared for (n=28)</i></b>		
Suspected case	11	39.3
Confirmed case	17	60.7
<b><i>Protective measures undertaken by COVID-19 patients (n=22)</i></b>		
Symptomatic wearing masks	12	54.5
Asymptomatic wear masks	6	27.3
Symptomatic unmasked	2	9.1
Asymptomatic unmasked	2	9.1
<b><i>Contact duration with COVID-19 patients (n=23)</i></b>		
<10 minutes	2	8.7
10–15 minutes	4	17.4
15–20 minutes	3	13.0
≥20 minutes	14	60.9
<b><i>Contact distance from COVID-19 patients (n=26)</i></b>		
<1.5 meters	24	92.3
≥1.5 meters	2	7.7

## Discussion

Worldwide, HCWs are at high risk of infection by SARS-CoV-2. In the early stages of the outbreak this was due to lack of understanding of the pathogenesis and mode of transmission of the virus, as well as a lack of appropriate protective measures.<sup>6</sup> Among 138 COVID-19 patients hospitalized in Wuhan, 29% were reported to be HCWs.<sup>7</sup> This study aimed to describe the baseline characteristics of HCWs in Saudi Arabia who had contracted COVID-19 and the protective measures they had taken to guard against infection, to better understand which HCWs are at risk of infection. Of 100 HCWs who had contracted COVID-19, approximately 90% were aged less than 40 years, which is comparable to the median age of COVID-19 cases in the Saudi population (36 years).<sup>8</sup> Smoking status was also almost comparable between COVID-19 cases in HCWs and those in the general population, in which more than two-thirds are non-smokers.<sup>8</sup> This younger population with fewer comorbidities and lower smoking rates could explain the low mortality rate of COVID-19 patients in Saudis compared to the rest of the world, as these are well-established independent risk factors.<sup>9,10</sup> There was a marked predominance of females (69.0%) over males (31.0%), consistent with a previous study in China, which reported a female dominance of 68.1% of COVID-19 cases among HCWs.<sup>5</sup> However, among the general Saudi population, males account for 54.3% of cases, indicating that they are infected at slightly higher rates than females.

With respect to the clinical picture of illness among HCWs, the five most prominent symptoms were fever (57.0%), followed by cough (53.0%), headache (43.0%), fatigue (33.0%), and loss of taste and smell (32.0%), similar to other recently reported studies.<sup>8,11,12</sup> As most of cases showed mild symptoms, two-thirds (67.0%) were isolated at home, while 27.0% were referred to quarantine hotels, and only 6.0% required hospitalization.

Adherence of HCWs to personal protective measures, hand hygiene, and following strict rules including social distance and wearing masks in public areas were sufficient to protect against SARS-CoV-2 infections, confirmed by negative serology, among 420 HCWs directly involved in the care of COVID-19 patients.<sup>5</sup> In this study, when dealing with COVID-19 cases, 93.1% of HCWs reported wearing a surgical mask and 61% wore a N95 mask, while between 69 and 80% reported wearing gloves, a disposable gown and eye protection. However, when caring for non-COVID-19 patients, much higher levels of noncompliance with personal protective measures were reported by HCWs (more than half), particularly the use of gloves, disposable gowns, and eye protection. This is consistent with previous reports that PPE is effective in reducing the risk of infection, while those who are noncompliant are at high risk,<sup>13</sup> and confirms previous reports that good hand hygiene and appropriate PPE, including masks, gloves, protective gowns, and goggles or face shields are adequate measures to reduce or even eliminate the risk of infection.<sup>5,14</sup> Greater efforts to increase HCWs' knowledge regarding the importance of following strict infection control measures are needed not only to reduce infection rates, but also the anxiety associated with dealing with COVID-19 cases. It has been reported that among 398 Saudi HCWs, the majority were worried about caring for COVID-19 patients, with infecting their families being the most commonly reported fear (92%).<sup>15</sup> Saudi Arabia has the advantage of previous experience with the Middle East respiratory syndrome coronavirus (MERS-CoV). HCWs who had previous experience with MERS-CoV were more likely to attend hospital awareness campaigns on COVID-19, have greater knowledge of and adherence to protective hygienic practices, and less anxiety regarding COVID-19 compared to those without previous experience.<sup>16</sup>

When asked about potential possible sources of infection, 60.3% of HCW cases reported that they had treated confirmed cases, while 39.3% had treated suspected cases. The procedures reported to increase the risk of infection were taking nasopharyngeal swabs (23.0%), inserting nasogastric tubes (22.0%), ventilation (17.0%), and tracheal intubation (14.0%). Hence, it is recommended that stricter protective measures are implemented during these procedures. Among 420 HCWs directly involved in these procedures in COVID-19 patients, following strict measures, including wearing both N95 and surgical masks at the same time, good hand hygiene, and training workers in how to perform these procedures and donning and doffing PPE, was sufficient to eliminate infection of HCWs.<sup>5</sup> It was also reported that most of the patients cared for wore masks, with less than 20% not being masked. However, that was not adequate to protect against infection, suggesting that it is the responsibility of HCWs to use PPE correctly, and that they should be offered updated training and education regarding appropriate PPE.

Lastly, when considering the distance between the patient and the HCW and the contact time that increases the risk of staff acquiring infections, almost two-thirds of the HCW cases confirmed that they had contact with COVID-19 patients for longer than 20 minutes, while 92.3% reported that they were within close proximity to their patients (<1.5 meters).

One of the limitations in a previous similar study is that it was not able to determine the minimal protective measures that may prevent infection in HCWs.<sup>5</sup> However, based on our results on a variety of forms of noncompliance with different types of PPE in HCWs who had acquired COVID-19, we confirm that there is no minimal limit to the personal protective measures required to



prevent infection. Full adherence to personal protective measures, including hand hygiene when working in COVID-19 areas and following strict rules regarding social distancing and wearing masks in public areas, is required to protect HCWs from infection.

A limitation of this study was its retrospective, cross-sectional design, which meant that there were considerable amounts of missing data where participants could not recall their practices perfectly. However, it gave us a good picture of the clinical characteristics of those at risk, which included risky behaviors, procedures, as well as the proximity and duration of contact. We were able to confirm there is no minimal limit for protective measures that may prevent infection, and thus full adherence to PPE is required.

### **Conclusion**

In conclusion, although the risk of infection has decreased compared to the beginning of the outbreak when the mode transmission was not fully understood, HCWs are still at high risk of infection with SARS-CoV-2. Since there is no minimal limit on the protective measures that may prevent infection, HCWs must be given adequate training in appropriate protective measures and updated regarding their importance, especially during risky procedures such as taking nasopharyngeal swabs, placing nasogastric tubes, ventilation, and tracheal intubation. Moreover, once a vaccine is available, healthcare professionals must be given priority.

### **Recommendation**

Analysis of the data obtained in this study demonstrates the significant of using personal protective equipment's effectively among health care workers and its vital role in reducing rate of infection transmission. However, further cohort study required in the same field to obtain a comprehensive outcomes.

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