

SARS-CoV-2 infection among primary healthcare workers: a cross-sectional study

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Introduction

Healthcare workers (HCWs) are critical to the healthcare system and are at an increased risk of SARS-CoV-2 infection.¹ They may acquire infections from the community and their work settings. To date, the majority of the studies reporting on the epidemiology of SARS-CoV-2 infections in HCWs, including serology testing, are from hospital settings.²

Primary care provides a platform and plays a critical role in prevention, testing, triaging and treating patients, but a smaller number of studies focus on primary care settings.³ In a recent systematic review, primary care physicians were at increased risk of worse outcomes and were the highest risk specialty for deaths among doctors.²

This short report provides an objective assessment of infection risk among frontline primary care HCWs utilizing RT-PCR results and

serology testing. The study aims to establish the point and the period prevalence of SARS-CoV-2 infection among HCWs and their characteristics, exposure risks and infection control practices for SARS-CoV-2 in primary care settings.

Overview

A cross-sectional study design was employed for the study. The study settings were Primary Health Care Corporation (PHCC) – the largest primary health care provider in Qatar. It has 27 health centers across the country with approximately 1.4 million registered individuals. The study was conducted in July 2020 during the first SARS-CoV-2 pandemic wave with approximately 163 new cases daily per million population. Five health centers were randomly selected for the study – Rawdat Al Khail, Gharrafat Al Rayyan, Al Wajbah, Qatar University and Al Wakrah. Suspected or confirmed SARS-CoV-2 individuals presented in all health centers at the time. All frontline physicians and nurses working in the five selected health centers were invited to participate in the study. Overall, 291 of the 720 invited participants consented to participate. HCWs were booked an appointment where they completed a self-administered questionnaire on sociodemographic, RT-PCR test results, SARS-CoV-2 exposure risk and provided a blood sample to test for antibodies (IgM and IgG) against SARS-CoV-2.

Laboratory procedures

The nasopharyngeal swabs were used to extract RNA, which was isolated prior to amplification on a number of platforms. These included: ExiPrep 96 Viral DNA/RNA Kit (Bioneer Corporation, South Korea, Cat Number K-4614); Chemagic STARS Viral DNA/RNA 300 Kit (Perkin Elmer, USA, Cat Number CMG-

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1774); EZ1 Virus Mini Kit v2.0 (QIAGEN, USA, Cat Number 955134); Nucleic Acid Extraction Kit (Wuhan MGI Tech Co Ltd, China, Cat Number 1000021043). Extracted nucleic acid underwent thermal cycling on ABI 7500 Thermal Cyclers (Thermo Fisher, USA) using a number of thermal mixes.

The blood samples were centrifuged. A quantity of 150 µL of plasma was used for detection of anti-SARS-CoV-2 antibodies using the CL-900i Chemiluminescence Immunoassay System (Mindray Bio-Medical Electronics Co, China) according to the manufacturer's instructions.

Data analysis

Proportions were calculated to describe prevalence. Pearson's Chi-square test was used to assess the statistical significance of associations between independent categorical variables. Exact significance testing (Fisher's exact) was used when conditions for a valid Chi-square test were violated (more than 20% of cells involved in an association have expected counts less than 5). P value less than 0.05 was considered statistically significant.

Ethical considerations

The study was reviewed and approved by PHCC's Independent Review Board (ref no. PHCC/DCR/2020/05/047). Informed consent was obtained from participants. Only MAS, ASAN and HAQ had access to the full study data. Overall, the study was conducted with integrity according to generally accepted ethical principles.

Population characteristics, exposure risk and infection control practices

The majority of the study population was female (211/291; 73%). The mean age of participants was 38.9 ± 7.3 years (median: 38 years; min-max: 27-62 years). A fifth of the study population had at least one chronic disease condition (62/291; 21%). Most of them had BCG vaccination (231/291; 82%), and a smaller number had an influenza vaccination for the current or past season (180/291; 62%).

Despite telephone consultations being available, most HCWs had face-to-face contact with individuals suspected or confirmed with SARS-CoV-2 infection (240/291; 86%). More than a third of these encounters were within 1-meter distance and for a duration over 15 minutes, fitting the description of high-risk encounters (98/291; 35%).

Adherence to infection control practices more than 95% of the time was high among the study population. Using masks during the consultation 95% of the time or more was the highest reported (278/283; 98%) followed by hand hygiene (259/267; 97%) and single-use gloves (254/279; 91%). Use of goggles/protective glasses 95% of the time was less reported (201/272; 74%), albeit levels were acceptable for primary care settings.

Point and period prevalence of SARS-CoV-2 infections

Table 1. Rates of positive SARS-CoV-2 test results among healthcare professionals

	N (%)
Past history of RT-PCR swab result	
Negative	252 (86.6%)
Positive	13 (4.5%)
Unknown (no record of testing)	26 (8.9%)
Total	291 (100%)
IgG antibodies	
Negative	275 (95.5%)
Positive	16 (5.5%)
Total	291 (100%)
IgM antibodies	
Negative	261 (89.7%)
Positive	30 (10.3%)
Total	291 (100%)
Any evidence of SARS-CoV-2 infection (positive RT-PCR and/or IgM antibody and/or IgG antibody test)	
Negative (all the three criteria being negative)	261 (83.5%)
Positive (one or more of the 3 criteria being positive)	48 (16.5%)
Total	291 (100%)

The study population's point prevalence using RT-PCR nasopharyngeal swab results was low (13/291; 4.5%). IgM antibodies for the study population were higher (30/291; 10.3%) suggesting a recent infection in that population. A lower number of participants had IgG suggesting an older infection (16/291; 5.5%). The period prevalence for the population using any positive for the three variables was (48/291; 16.5%) – Table 1.

Associations between population characteristics, infection control practices and any evidence of SARS-CoV-2 infection

HCWs characteristics, exposure risk and infection prevention and control practices less than 95% of the time were not associated with an increased risk of having SARS-CoV-2 evidence of infection (Table 2).

Discussion

HCWs in primary care settings are at increased risk of SARS-CoV-2 infections that are no less reported in hospital settings. The period prevalence using serology test results was 16%, more than three times the point prevalence using RT-PCR positive results. Period prevalence is more representative of the cumulative occupational risk among the HCWs.

The sociodemographic and clinical characteristics associations lacked statistical significance. The findings differ from the general population where age and past medical history of chronic disease increased the risk of infection.⁴

Exposure risk to SARS-CoV-2 infections among PHCC HCWs was high. Despite the deployment of telephone consultations and using a face-to-face consultation only when necessary, most HCWs had direct contact with patients with SARS-CoV-2 infection and more than a third of them were exposed to high-risk encounters for longer than 15 minutes. However, these findings cannot explain the increased risk among the study population and high-risk encounters did not have statistically significant associations with the positive RT-PCR or serology results. Similarly, adherence to infection control practices was high, which might have negated the

risk inherited, but no associations were established.

Of note, positive RT-PCR and serology results may change with time⁵ and our results might be lower than the actual cumulative occupational risk of infection. The high proportion of IgM suggests more recent infections, which may be attributed to changes in behaviors and adherence to training over time. Therefore, it is necessary to consider having a continuous and ongoing infection prevention and control training programme for HCWs.

While this study has many strengths, such as the inclusion of HCWs in primary care setting and estimating point and period prevalence of SARS-CoV-2 infection amongst them, it also has some limitations. These include use of a convenience sampling technique and self-administered questionnaire. However, the study was undertaken in difficult circumstances and urgency of the situation. Nevertheless, the results add significant value and are of interest to highlight the heroic role healthcare workers play in the pandemic, and despite the different mechanisms in play, they continue to be at substantial risk.

Authors' contributions statement: HAQ, EH and MAS prepared the first draft of the manuscript. ASA and EH undertook data analysis. AAS, GKN and AAA reviewed the final version of the manuscript. All authors read and approved the final version of the manuscript.

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Table 2. Healthcare professionals' characteristics, exposure risk and infection control practices

	Evidence of SARS-CoV-2 infection		P value
	Negative N (%)	Positive N (%)	
HCW characteristics			
Gender			0.776 [NS]
Female	177 (72.8%)	34 (70.8%)	
Male	66 (27.2%)	14 (29.2%)	
Total	243 (100%)	48 (100%)	
Age group (years)			
<30	15 (6.2%)	0 (0%)	0.170 [NS]
30-39	127 (52.3%)	23 (47.9%)	
40-49	84 (34.6%)	19 (39.6%)	
50+	17 (7%)	6 (12.5%)	
Total	243 (100%)	48 (100%)	
Prior BCG vaccination			
Negative	41 (17.4%)	8 (17.8%)	0.957 [NS]
Positive	194 (82.6%)	37 (82.2%)	
Total	235 (100%)	45 (100%)	
Prior influenza vaccine (for the current or past season)			
Negative	66 (29.9%)	18 (41.9%)	0.122 [NS]
Positive	155 (70.1%)	25 (58.1%)	
Total	221 (100%)	43 (100%)	
History of chronic disease			
Negative	191 (78.6%)	38 (79.2%)	0.930 [NS]
Positive	52 (21.4%)	10 (20.8%)	
Total	243 (100%)	48 (100%)	

Face-to-face contact with a suspected or confirmed COVID-19 patient (within 1 m distance)			0.807 [NS]
Negative	42 (17.3%)	9 (18.8%)	
Positive	201 (82.7%)	39 (81.3%)	
Total	243 (100%)	48 (100%)	
Face to face contact with non-COVID-19 patients			0.864 [NS]
No	40 (17.9%)	8 (19%)	
Yes	183 (82.1%)	34 (81%)	
Total	223 (100%)	42 (100%)	
Adherence to infection prevention and control practices			
Effective use of single-use gloves (95% of the time or more frequently)			0.812 [NS]
Negative	44 (18.9%)	8 (17.4%)	
Positive	189 (81.1%)	38 (82.6%)	
Total	233 (100%)	46 (100%)	
Effective use of medical mask (95% of the time or more frequently)			0.142 [NS]
Negative	15 (6.3%)	0 (0%)	
Positive	222 (93.7%)	46 (100%)	
Total	237 (100%)	46 (100%)	
Effective use of face shield or goggles/protective glasses (95% of the time or more frequently)			0.293 [NS]
Negative	113 (49.6%)	18 (40.9%)	
Positive	115 (50.4%)	26 (59.1%)	
Total	228 (100%)	44 (100%)	
Effective use of disposable gown (95% of the time or more frequently)			0.134 [NS]
Negative	118 (52%)	17 (39.5%)	
Positive	109 (48%)	26 (60.5%)	
Total	227 (100%)	43 (100%)	
Remove and replace PPE according to the protocol			0.436 [NS]
Negative	27 (12%)	3 (7%)	
Positive	198 (88%)	40 (93%)	
Total	225 (100%)	43 (100%)	
Perform hand hygiene according to the protocol			1 [NS]
Negative	13 (5.8%)	2 (4.7%)	
Positive	211 (94.2%)	41 (95.3%)	
Total	224 (100%)	43 (100%)	

HCW – healthcare worker; NS – not statistically significant; PPE – personal protective equipment.

Any evidence of SARS-CoV-2 infection include positive RT-PCR and/or IgM antibody and/or IgG antibody test. Negative is defined as all the three criteria being negative. Positive is defined as one or more of the 3 criteria being positive.