

Concise Communication

Coronavirus disease 2019 (COVID-19) symptoms, patient contacts, polymerase chain reaction (PCR) positivity and seropositivity among healthcare personnel in a Maryland healthcare system

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Abstract

In a large, system-wide, healthcare personnel (HCP) testing experience using severe acute respiratory coronavirus virus 2 (SARS-CoV-2) polymerase chain reaction (PCR) and serologic testing early in the coronavirus disease 2019 (COVID-19) pandemic, we did not find increased infection risk related to COVID-19 patient contact. Our findings support workplace policies for HCP protection and underscore the role of community exposure and asymptomatic infection.

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The severe acute respiratory syndrome (SARS) outbreak of 2003 disproportionately affected healthcare personnel (HCP): in Vietnam, 57% of those infected were HCP and in Canada 43% of those infected were HCP.¹ HCP are critical to the coronavirus disease 2019 (COVID-19) pandemic response, and HCP protection has focused on policies and personal protective equipment (PPE) to prevent COVID-19 infection in the healthcare workplace.² Yet little information is available regarding the types of exposures associated with positive COVID-19 cases among HCP, and data linking severe acute respiratory coronavirus virus 2 (SARS-CoV-2) serology with previous history of polymerase chain reaction (PCR) positivity among this critical workforce are limited. In this study, we aimed (1) to describe the relationship between HCP self-reported COVID-19 patient contact and the likelihood of positive serology, (2) to examine the risk of testing positive based on symptoms and location of exposure in a cohort of HCP presenting for SARS-CoV-2 PCR testing; and (3) to assess the association between PCR positivity and serology results among HCP.

Methods

This cohort study was conducted across 13 hospitals (12 acute-care hospitals and 1 specialty rehabilitation hospital) affiliated with a

single academic healthcare system in Maryland. Policies have required (1) the use of high-level PPE defined as respirator, eye protection, gloves, and gowns for all contact with patients with suspected or confirmed COVID-19 since the beginning of the pandemic; (2) extended use and decontamination for N95 mask conservation; (3) universal masking and eye protection for all patient contact since April 1, 2020; and (4) universal patient admission testing since May 6, 2020.

To evaluate the association between the extent of COVID-19 patient contact and HCP seropositivity, we examined self-reported HCP contact with COVID-19 patients between March 1 and July 31, 2020, and results from employer-initiated serology testing from June 1 to August 31, 2020. HCP were instructed to complete an electronic form each time they interacted with a confirmed or suspected COVID-19 patient to report PPE use and any breaches (Supplementary Material online). The Wilcoxon rank-sum test and the χ^2 test were used to compare seropositive and seronegative HCP on COVID-19 patient contact characteristics, prior to serology testing. To evaluate SARS-CoV-2 PCR positivity risk by type of exposure, we examined data collected between March 1 and August 31, 2020, through a nurse practitioner-staffed hotline for employees calling to report symptoms or exposure and undergo PCR testing. Logistic regression was used to estimate the association between self-reported exposure type and SARS-CoV-2 PCR positivity. Lastly, we compared HCP serology results from June 1 to August 31, 2020, with PCR test results if they occurred within 3 months to 2 weeks prior to the serology test. This study was approved by the University of Maryland–Baltimore Institutional Review Board.

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Table 1. COVID-19 Patient Interaction Details Among Seropositive and Seronegative Healthcare Personnel

Interaction Detail	Seropositive Contacts Among 20 Seropositive HCP (N = 39), No. (%)	Seronegative Contacts Among 749 Seronegative HCP (N = 1,604), No. (%)	P Value
HCP did not wear all recommended PPE	6 (15.4)	186 (11.6)	.47
Patient did not wear a mask	19 (48.7)	1,018 (63.5)	.06
Extensive body contact eg, turning or bathing patient	16 (41.0)	659 (41.1)	.99
Aerosol-generating procedure or uncontrolled secretions	1 (2.6)	247 (15.4)	.03

Note. HCP, healthcare personnel; PPE, personal protective equipment.

Table 2. Association Between Self-Reported Exposure Type and Positive COVID-19 PCR Test in a Cohort of Healthcare Personnel Presenting for SARS-CoV-2 PCR Testing (N = 2,348)

Exposure Type	COVID Positive (N = 178), No. (%)	COVID Negative (N = 2,170), No. (%)	Odds Ratio (95% CI)	P Value
Patient exposure	55 (5.9)	873 (94.1)	1.00	1.00
Colleague exposure	45 (4.4)	968 (95.6)	0.74 (0.49–1.11)	.14
Community exposure (outside the household)	33 (15.1)	185 (84.9)	2.83 (1.79–4.48)	<.0001
Family or relationship exposure (inside the household)	45 (23.8)	144 (76.2)	4.96 (3.22–7.64)	<.0001

Note. CI, confidence interval.

Results

COVID-19 patient contact and seropositivity

From March 1 to July 31, 1,866 unique HCP reported 3,651 contacts with suspected or confirmed COVID-19 patients. Of those, 778 HCP had serology testing. 20 HCP (2.6%) were seropositive and reported 39 contacts with COVID-19 patients prior to their serology test, while 749 (96.3%) were seronegative and reported 1,604 contacts with COVID-19 patients prior to their serology test. This seroprevalence in our study sample is comparable to the seroprevalence (3%) among all 10,559 HCP who participated in our healthcare system serology testing initiative, reported elsewhere.³ We detected no difference between seropositive and seronegative HCP in the number of reported contacts with COVID-19 patients, in the proportion of contacts where HCP reported not wearing all recommended PPE, when the patient was not wearing a mask, or when there was extensive body contact with the patient (eg, turning) (Table 1).

Symptoms and community versus workplace exposure among HCP presenting for PCR testing

From March 1 to August 31, 2020, 5,135 HCP calling the employee hotline underwent diagnostic SARS-CoV-2 PCR testing due to COVID-19 symptoms or exposure. This testing constituted ~75% of all recorded HCP testing; the remainder were tested outside our system. Among them, 342 (6.7%) had a positive PCR test: 301 (88%) were symptomatic and 41 (12%) were asymptomatic at the time of the call, with test positivity of 9.7% (301 of 3,095) and 2.0% (41 of 2,040), respectively. In total, 2,787 HCP (54.3%) did not report a known workplace or community exposure. Among 2,348 HCP reporting exposures, 928 (39.5%) were patient exposures, 1,013 (43.1%) were colleague exposures, 218 (9.3%) were community, nonhousehold exposures, and 189 (8.1%) were household exposures. Compared to HCP with patient exposures, the odds of testing positive were significantly higher amongst HCP with known household exposures (OR, 4.96; 95% CI, 3.22–

7.64; $P < .0001$) and community, nonhousehold exposures (OR, 2.83; 95% CI, 1.79–4.48; $P < .0001$) but not with colleague exposures in the workplace (OR, 0.74; 95% CI, 0.49–1.11; $P = .14$) (Table 2).

Seroprevalence and correlation with PCR results

Of 319 seropositive HCP, 89 (27.9%) had a documented SARS-CoV-2 PCR test and 44 (13.8%) had a positive PCR result prior to their serologic testing. One seronegative HCP had a documented positive SARS-CoV-2 PCR 47 days prior to serology testing.

Discussion

In this analysis of a large healthcare system's employee exposure reporting and testing experience during the early months of the COVID-19 pandemic, we found low risk of HCP acquiring COVID-19 from patient contact. This result was observed both when evaluating SARS-CoV-2 seropositivity among HCP providing direct COVID-19 patient care and when comparing likelihood of SARS-CoV-2 PCR positivity based on patient versus community exposures. This finding supports the effectiveness of hospital-based measures at preventing transmission from patients to HCP and is consistent with findings from a large HCP serosurvey in 3 states.² In contrast, a study of 99,795 frontline HCP in the United Kingdom and the United States found an increased COVID-19 risk among those who provided care to patients with suspected or confirmed COVID-19 compared with those who did not.⁴ Although these 2 studies are not directly comparable, in that study, the difference in risk of COVID-19 between HCP and general community was more pronounced in the United Kingdom than in the United States and was higher among HCP reporting PPE reuse, suggesting that both national and local PPE policies may contribute to this risk.

Our results show that community and particularly close household exposure are associated with SARS-CoV-2 PCR test positivity

among HCP, consistent with prior data on COVID-19 attack rates.⁵ Only 14% of seropositive HCP had a documented previous positive PCR test, and among symptomatic HCP calling for PCR testing, only half were aware of known exposure to COVID-19. Together, these findings underscore the significant contribution of asymptomatic and presymptomatic SARS-CoV-2 infection to transmission⁶ and the underestimation of infections based on PCR testing during the early pandemic period when testing was not widely available or readily performed among asymptomatic individuals.

This study has several limitations. Not all HCP would have consistently reported COVID-19 patient contact. Only 41% of those reporting patient contact had serologic testing performed; however, HCP job roles were similar among those who participated in the serology initiative and those who did not (Supplementary Table 1 online). These factors, along with the requirement for all HCP to wear face masks, might have contributed to the lack of association of seropositivity with not wearing all recommended PPE. Exposure types reported to the employee hotline were based on self-reporting, which has the potential for inconsistency in exposure determination. HCP receiving COVID-19 diagnostic testing outside of employee testing sites were not included in this analysis.

In summary, our findings support institutional workplace policies for HCP protection. These findings highlight the need for prevention of HCP COVID-19 exposure in the community, and they suggest the possible underestimation of SARS-CoV-2 infection and exposure burden in HCP based on limited PCR-based diagnostic testing early in the pandemic.

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2021.373>

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Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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