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COVID-19 Seroprevalence in ED Health Care Professionals Study: A Cross-Sectional Study

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Contribution to Emergency Nursing Practice

- ED health care professionals are often the first point of hospital contact for patients with an acute illness. There were concerns that ED health care professionals may have been at increased risk of exposure to SARS-CoV-2.
- At a single institution, there was a seroprevalence of 2.9% for SARS-CoV-2 antibodies among ED health care professionals who had never been formally diagnosed with COVID-19.
- Adherence to infection control protocols, including implementation of universal masking and use of appropriate personal protective equipment for patients with suspected or confirmed COVID-19 or confirmed exposures, can effectively mitigate risk of transmission in health care settings.

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Abstract

Introduction: ED health care professionals are at the frontline of evaluation and management of patients with acute, and often undifferentiated, illness. During the initial phase of the SARS-CoV-2 outbreak, there were concerns that ED health care professionals may have been at increased risk of exposure to SARS-CoV-2 due to difficulty in early identification of patients. This study assessed the seroprevalence of SARS-CoV-2 antibodies among ED health care professionals without confirmed history of COVID-19 infection at a quaternary academic medical center.

Methods: This study used a cross-sectional design. An ED health care professional was deemed eligible if they had worked at least 4 shifts in the adult emergency department from April 1, 2020, through May 31, 2020, were asymptomatic on the day of blood draw, and were not known to have had prior documented COVID-19 infection. The study period was December 17, 2020, to January 27, 2021. Eligible participants completed a questionnaire and had a blood sample drawn. Samples were run on the Roche Cobas Elecsys Anti-SARS-CoV-2 antibody assay.

Results: Of 103 health care professionals (16 attending physicians, 4 emergency residents, 16 advanced practice professionals, and 67 full-time emergency nurses), only 3 (2.9%; exact 95% CI, 0.6%-8.3%) were seropositive for SARS-CoV-2 antibodies.

Discussion: At this quaternary academic medical center, among those who volunteered to take an antibody test, there was a low seroprevalence of SARS-CoV-2 antibodies among ED clinicians who were asymptomatic at the time of blood draw and not known to have had prior COVID-19 infection.

Key words: COVID-19 seroprevalence; COVID-19 antibody; SARS-CoV-2 antibody; SARS-CoV-2 seroprevalence

Introduction

ED health care professionals (HCPs) are often the first point of hospital contact for patients with an acute illness. Because of this, ED HCPs may encounter patients with communicable diseases before identification and isolation and in environments of care where effective patient isolation may be more challenging owing to ED capacity constraints and rapid turnover of patients.[1-4]

Early reports in 2020 documented elevated risk to HCPs, including in Italy, where nearly 2 in 10 people infected with COVID-19 were HCPs and in China, where health care workers constituted 14% of initial COVID-19 infections.[5] However, more recent larger studies have demonstrated that the risk of occupational exposure and acquisition is low, and that SARS-CoV-2 infection in HCPs is associated with community and demographic risk factors and not occupational risks.[6,7] In 2020, in a multistate hospital network study involving 13 academic medical centers, the authors found that seroprevalence among HCPs correlated with community COVID-19 incidence.[6] Moreover, in 2020, in a hospital-wide screening study at a Tertiary Center in Belgium, researchers found that having a household contact with COVID-19 was associated with seropositivity when compared with having no household exposure. They did not find a correlation with a health care worker being involved in the clinical care of patients with COVID-19.[7]

Understanding the prevalence of COVID-19 antibodies among ED HCPs without prior infection knowledge sheds light on occult infection rates among ED professionals and could further guide efforts to protect health care coworkers and patients.

Methods

STUDY DESIGN

We performed a prospective, cross-sectional study to estimate SARS-CoV-2 seroprevalence among ED HCPs, defined as attending physician, emergency resident physician, advanced practice provider, or full-time emergency nurse. An ED HCP was deemed eligible for the study if they had worked at least 4 shifts in the adult emergency department within and including the dates of April 1, 2020, and May 31, 2020. This period corresponded with the initial surge of COVID-19 in Massachusetts with a peak of 2988 confirmed COVID-19 cases on April 17, 2020.[8] The HCP also needed to be asymptomatic on the day of the blood draw and not known to have had a prior documented COVID-19 infection. Blood was drawn from December 17, 2020, until January 27, 2021.

ED HCPs were sent an email inviting them to participate and were assessed for eligibility on the basis of study inclusion criteria. Eligible participants were then invited to enroll in the study and verbally consented. Participants

completed a questionnaire in REDCap (Research Electronic Data Capture; https://projectredcap.org/resources/citations/), which is a secure, web-based software platform designed to support data capture for research studies, and scheduled a blood draw.[9] Samples were analyzed using the Roche Cobas Elecsys (Roche Diagnostics, Indianapolis, IN) Anti-SARS-CoV-2 total antibody assay. This assay has emergency use authorization from the Food and Drug Administration for the qualitative detection of SARS-CoV-2 antibodies. It detects IgM, IgA, and IgG antibodies to the SARS-CoV-2 nucleocapsid antigen with reported specificity of >99% and analytic sensitivity of >90%.[10,11] When the test is performed more than 2 weeks after symptom onset in patients infected with COVID-19, the analytical sensitivity approaches 100%.[10-12] This particular antibody test was chosen as it met the specificity guidance from the Infectious Diseases Society of America when performing seroprevalence studies to avoid false positives.[13] If the antibody test was positive, the subject subsequently underwent SARS-CoV-2 nucleic acid amplification testing (NAAT) from a nasopharyngeal swab to assess for active infection. Of note, vaccination for SARS-CoV-2 at our study site had just started in late December of 2020. However, the Cobas Elecsys Anti-SARS-CoV-2 total antibody assay only detects antibodies to the SARS-CoV-2 nucleocapsid antigen, which indicates infection by exposure rather than immunization by vaccination.[14]

In addition, using the electronic health record, we identified each subject's number of encounters with ED patients with confirmed COVID-19 (diagnosed before ED arrival or diagnosed based on NAAT performed in the emergency department) from April 1, 2020, to the day before the blood draw date. The participant must have either assigned themselves to the patient's treatment team or written a note in the patient's chart for the encounter to be included in the analysis.

SETTING

The study was performed in Boston at an emergency department of an urban, 1043-bed quaternary care academic center with level I trauma center designation and an Accreditation Council for Graduate Medical Education–accredited 4-year emergency medicine residency program. At this institution, patients are cared for by resident physicians or advanced practice providers (physician assistants and nurse practitioners), attending emergency physicians, and emergency nurses. Before March 6, 2020, the personal protective equipment (PPE) required for HCPs interacting with patients with suspected or confirmed COVID-19 or confirmed COVID-19 exposures included gowns, gloves, eye protection, and N95 respirator. Between March 6 and March 21, 2020, the PPE requirement for respiratory protection changed from an N95 respirator to a surgical or procedural mask, with N95 respirators reserved for aerosol-generating procedures. On March 22, 2020, universal masking was implemented for all HCPs; universal masking for all patients and visitors was instituted on April 6, 2020. On April 10, 2020, the PPE policy for HCPs changed to gown, gloves, eye protection, and N95 respirator for all patients with suspected or confirmed COVID and confirmed COVID-19 exposures. Recommended PPE was consistently available at this institution.

This study was approved by our institutional review board (Protocol# 2020P002587).

Results

Of the 446 ED HCPs invited to participate, 163 (37%) completed the eligibility questionnaire. Of the 163 HCPs, 60 (37%) did not schedule a blood draw. Subsequently, a total of 103 (23%) HCPs (16 attendings, 4 emergency residents, 16 advanced practice providers, and 67 nurses) had blood samples drawn and completed the survey. Eighty-one (79%) of 103 HCPs were female. Of the 103 HCPs, 3 (2.9%; 95% CI, 0.6%-8.3%) were seropositive for SARS-CoV-2 antibodies. One was an attending physician, one was an advanced practice provider, and one was an emergency nurse. All 3 had subsequent negative SARS-CoV-2 NAAT results. Additional characteristics of the seronegative and seropositive participants are summarized in the Table.

When asked whether coworkers wore the recommended PPE when caring for patients with confirmed or suspected COVID-19, 47% of respondents strongly agreed, 48% agreed, and 3% disagreed with the statement. When asked whether the study participant wore the recommended PPE when caring for patients with confirmed or suspected COVID-19, 68% strongly agreed, 33% agreed, and 1% disagreed with the statement.

Discussion

At a single quaternary academic medical center among those who volunteered to take an antibody test, we found a seroprevalence of 2.9% for SARS-CoV-2 antibodies among our ED HCPs who had never been formally diagnosed with COVID-19. In 2020, Wang et al[15] reported the same seroprevalence rate of 2.9% at their academic medical center in San Francisco, CA, but lower than that reported by Madsen

TABLE
Seroprevalence of SARS-CoV-2 antibody and exposure characteristics

Characteristics	Reported responses among seronegative HCPs (n = 100)				Reported responses among seropositive HCPs (n = 3)			
	Yes		No		Yes		No	
1. Between and including the dates of April 1, 2020, and May 30, 2020, I participated in aerosol-generating procedures (eg, intubation/extubation, chest compressions, nebulization, non-invasive positive pressure ventilation, high flow nasal cannula at >15L, etc.)	74	74%	26	26%	3	100%	0	0%
2. Were you notified by Occupational Health Services that you were exposed to an individual with COVID-19 (ie, notified of confirmed exposure)?	52	52%	48	48%	1	33%	2	66%
Who was the individual with confirmed COVID-19?								
Fellow employee	2	4%	-	-	0	0%	-	-
Patient	48	92%	-	-	1	100%	-	-
Do not know	2	4%	-	-	0	0%	-	-
3. Since April 1, 2020, I have clinically worked outside of the study site emergency department to care for patients with confirmed or suspected COVID-19 (ie, other hospital emergency departments, other floors/ICUs at or outside of study site, etc.)	24	24%	76	76%	1	33%	2	66%
4. I have had household contact with persons with diagnosed COVID-19	5	5%	95	95%	0	0%	3	100%
5. Outside the hospital, I have had non-household contact with persons with diagnosed COVID-19 (ie, community exposure)	6	6%	94	94%	0	0%	3	100%
6. Since April 1, 2020, I have attended a social function or gathering with 2 or more people outside of my household	73	73%	27	27%	2	66%	1	33%
Did you adhere to social distancing and/or mask guidelines?								
Yes (social distancing)	13	18%	-	-	1	50%	-	-
Yes (masking)	5	7%	-	-	0	0%	-	-
Yes (social distancing and masking)	38	52%	-	-	1	50%	-	-
No	17	23%	-	-	0	0%	-	-
7. I think I have had COVID-19 infection	17	17%	83	83%	2	66%	1	33%
8. Median number (interquartile) of COVID-19 encounters	39 (43)				68 (31)			

HCP, health care professional; ICU, intensive care unit.

et al,[16] which was 5.9% at their academic medical center in Salt Lake City, UT. However, both of these studies included participants with known prior COVID-19 infection or active symptoms of COVID-19. Moreover, in 2020, Stubblefield et al,[17] assessing seropositivity in ED and intensive care unit HCPs, found a seroprevalence rate of 7.6% among frontline health care personnel during the first month of caring for patients with COVID-19. The seroprevalence rate among personnel who recalled no symptoms was 3.2%.[17]

A substantial proportion of enrolled HCPs (19 of 103) suspected that they had been infected previously and were anticipating positive SARS-CoV-2 titers. Our results, however, suggest that the frequency of COVID-19 infection was lower than what our frontline HCPs predicted. Of the 19 participants believing that they had prior COVID-19 infection, only 2 (11%) of them were seropositive. This could be due to the nonspecific symptoms of COVID-19 and the similarities to other respiratory viral infections. This could also be due to waning immunity.[18] These results may also indicate concerns among participants about contracting SARS-CoV-2 after reflecting on their own behaviors and baseline risk. For example, among seronegative HCPs, 73% had attended a social function. While 68% of HCPs strongly agreed that they wore the recommended proper PPE, only 47% strongly agreed that their colleagues wore the recommended proper PPE. On the basis of the survey results, adherence to proper PPE was likely high. Of note, a quarter of respondents practiced at another site. Although this study is unable to ascertain risk of contracting COVID-19 in clinicians working at multiple facilities, staff working in multiple facilities may be associated with the interfacility spread of COVID-19.[19]

Limitations

The primary limitation of the study is selection bias, and the results should be interpreted with caution. It is possible that those who did not respond were more or less likely to have contracted COVID-19 than our sample population. It is plausible that those who enrolled in our study would be more likely to believe that they had previously contracted COVID-19, making it unlikely that the true seroprevalence is significantly higher than our results. A second limitation is the time elapsed between the first pandemic surge and the study period. Some subjects may have been SARS-CoV-2 seropositive and over time converted to seronegative. A third limitation is that we were precluded from doing an analysis of potential risk factors for having antibodies because we did not collect demographic information, and there was a low number of subjects with a positive antibody test. Finally, our results may not be generalizable to hospitals that were unable to secure sufficient quantities of PPE or were unable to implement infection prevention and control strategies recommended by public health.

Implications for Emergency Nurses

Adherence to infection control protocols, including implementation of universal masking and use of appropriate PPE for patients with suspected or confirmed COVID-19 or confirmed exposures appears to mitigate risk of transmission in health care settings. Health care leaders should ensure that staff have access to and use recommended PPE.

Conclusion

At a single quaternary academic medical center among those who volunteered to take an antibody test, there was a low seroprevalence of SARS-CoV-2 antibodies among ED HCPs who were asymptomatic at the time of blood sampling and not known to have had prior documented COVID-19 infection. Seropositivity was considerably lower than participants themselves anticipated, suggesting that PPE and other infection control protocols were more effective than HCPs believed. While there have been concerns about asymptomatic infections in health care workers—and the downstream consequences—it appears this was in fact a rare occurrence in our ED setting.

Author Disclosures

Conflicts of interest: none to report.

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