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Exposure and seroconversion to severe acute respiratory syndrome coronavirus 2 among obstetrical healthcare providers following a contained outbreak

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OBJECTIVE: Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which has developed into a global pandemic with vast social, economic, and health consequences. High transmissibility in asymptomatic individuals makes controlling viral spread difficult and poses unprecedented challenges to healthcare systems. At the onset of the pandemic in the United States, 19% of reportable cases were healthcare workers (HCWs) with the majority reporting exposure within the workplace.[1] Although hospital protocols have morphed with increasing available data, there continues to be a variation in screening, testing, and personal protective equipment (PPE) use across the country.

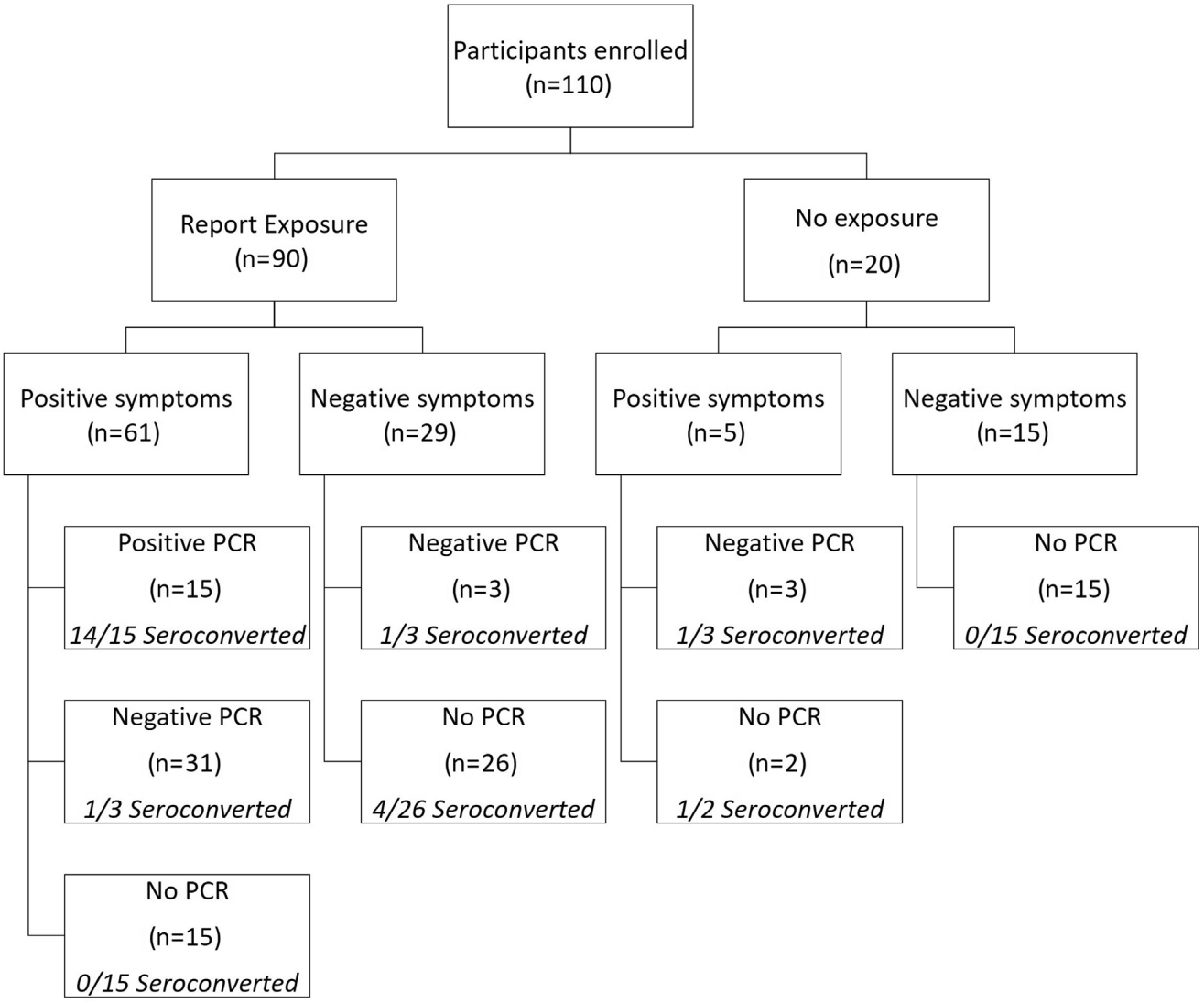
Obstetrical units are an underestimated hotspot in the pandemic, owing to an asymptomatic population, high patient turnover, integrated workstations, and frequent emergencies requiring response from multiple disciplines and expedient transfer to onsite surgical suites. These factors underscore current advocacy from professional obstetrical and anesthesia societies for universal PPE in obstetrical units and the use of N95 masks during vaginal deliveries of infected patients because of suspected aerosolization during this procedure.[2,3] Therefore, we investigated the exposure and seroconversion to SARS-CoV-2 among obstetrical HCWs in a tertiary care center.

STUDY DESIGN: This prospective cohort study investigated SARS-CoV-2 antibody levels in obstetrical HCWs at a tertiary hospital with approximately 5500 deliveries per year. The study included HCWs employed in the inpatient obstetrical unit. Written consent was obtained, and blood samples were obtained at 2 time points 4 weeks apart, with baseline collection beginning March 25, 2020, and follow-up on April 23, 2020. Data regarding the demographics, symptoms, previous nasopharyngeal polymerase chain reaction (PCR) results for SARS-CoV-2, and the timing of high-risk exposures were collected through a voluntary written survey.

Immunoglobulin M (IgM) and Immunoglobulin G (IgG) levels in the serum were measured from whole blood samples of all study participants at the 2 time points using a validated SARS-CoV-2 enzyme-linked immunosorbent assay (ELISA) per manufacture's protocol (Novel Coronavirus COVID-19 IgG ELISA Kit; Epitope Diagnostics Inc, San Diego, CA).[4] The optical density ratio for positive IgM was >0.201 (negative cutoff value of <0.179) and positive IgG was >0.439 (negative cutoff value of <0.359). The minimal detectable concentration for IgM and IgG was 5 IU/mL. The inter- and intra-assay coefficients of variation were <15% and <20%, respectively. Participants were considered to have seroconverted if they had a positive result for IgM or IgG. Specimen collection began in accordance with institutional biorepository (Institutional Review Board [IRB] study #2013H0404), and specimen and data analysis continued with additional institutional approval (IRB study #2020H0133).

Of note, an outbreak of SARS-CoV-2 among obstetrical HCWs in our inpatient unit occurred between baseline and follow-up blood collection, with the first positive case on March 26, 2020. Mandatory employee temperature and

FIGURE
Flow diagram by exposure, symptoms, SARS-CoV-2 PCR results, and seroconversion



Flow diagram detailing number of participants reporting exposures and symptoms and which seroconverted on antibody testing.

PCR, polymerase chain reaction; *SARS-CoV-2*, severe acute respiratory syndrome coronavirus 2.

Kiefer. Exposure and seroconversion to severe acute respiratory syndrome coronavirus 2 among obstetrical healthcare providers. Am J Obstet Gynecol 2020.

symptom screening began on March 27, 2020, and universal masking was enforced on April 1, 2020.

RESULTS: A total of 110 obstetrical HCWs completed the survey and blood collection at the 2 time points. All participants were female with a median age of 34 years (interquartile range, 28.8–45.0) and predominantly white (86%). Most participants were registered nurses (68.2%), followed by obstetrical and anesthesia physicians (24.5%). At the time of the follow-up collection, 90 participants (82%) reported exposure to SARS-CoV-2; 66 (60%) reported 1 or more COVID-19 symptoms; 52 (47%) had nasopharyngeal PCR testing, of which 15 (29%) received a positive result for the virus (Figure and Supplemental Table).

At baseline, 3 (2.7%) of the participants had positive antibodies, whereas 22 (20%) had positive antibodies at the time of the follow-up collection. A total of 14 (93%) of the participants who received a positive result for SARS-CoV-2 by nasopharyngeal PCR seroconverted. Notably, 3 (8.1%) participants who received a negative result for nasopharyngeal PCR had positive antibodies. An additional 2 participants had positive IgM and IgG antibodies on baseline sample and an IgG that persisted at 4 weeks; both were asymptomatic and did not undergo nasopharyngeal PCR testing. Furthermore, 3 participants without any

nasopharyngeal PCR testing seroconverted to IgM only at 4 weeks. In total, 5 participants (4.5%) who reported being asymptomatic seroconverted at either of the 2 time points (Figure and Supplemental Figure).

Reported symptoms in this cohort varied from headache (77.3%) as the most common to chest pain (18.2%) as the least. However, the most predictive symptoms for any positive SARS-CoV-2 test result (PCR or antibody) were loss of taste and loss of smell, both independently with a positive predictive value, sensitivity, and specificity of 87.5%, 60.9%, and 97.7%, respectively.

CONCLUSION: Limited data are available on antibody testing for SARS-CoV-2 and our study presents seroconversion rates in high-risk HCWs after a contained outbreak within our unit. About 20% of our participants received a positive result for SARS-CoV-2 antibodies, and all but 1 participant that received a positive result for COVID-19 based on PCR had evidence of seroconversion (93%). Of further interest, antibody testing was positive in 3 participants who received negative PCR test results and 5 participants who reported no symptoms at all. In addition, our study evaluated a broad range of associated symptoms and found a loss of taste and smell to be the most predictive, which is a finding similar to other published reports.[5]

Emerging data have identified large asymptomatic cohorts who had a positive result for SARS-CoV-2 and are likely responsible for substantial community spread. Supply shortages initially limited hospital PPE to patients with suspected COVID-19 infections. As more information became available, our institution was quick to transition to a policy of universal employee screening and masking. Baseline laboratories were collected before this change in policy and before a SARS-CoV-2 outbreak among HCWs within our inpatient obstetrical unit. This contributed to the high number of reported exposures in our cohort (82%). Importantly, we found that none of our participants received a positive result for SARS-CoV-2 by nasopharyngeal PCR beyond the expected incubation period once universal masking was implemented. Our experience is not unique, and our effectiveness in containing the outbreak with these measures is similar to that reported from a maternity ward in Germany.[6]

Our study is limited by potential for recall bias on voluntary surveys and the novel nature of SARS-CoV-2 antibody testing. Although our cohort is made up entirely of females, we believe that this is not a limitation. Obstetrics is female-predominant, and our data are generalizable to this healthcare field. Furthermore, we suspect that our experience is not unique and rather is a representation of underlying trends in labor and delivery units throughout the country. This study is strengthened by a robust sample size and longitudinal design. We recruited and analyzed samples from a large cohort in a high-risk area of healthcare. To the best of our knowledge, this is the largest reporting of longitudinal antibody testing in obstetrical HCWs. Future directions of this study lend itself to continued serial antibody measurements in this cohort to assess the prevalence of the disease in this population and the rates and persistence of seroconversion over time.

Our study highlights the need for PPE, workspace distancing, good hand hygiene, and universal screening in labor and delivery units to prevent infectious outbreaks driven by asymptomatic transmission of respiratory pathogens, such as the novel coronavirus. ■

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This communication has been published in the middle of the COVID-19 pandemic and is available via expedited publication to assist patients and healthcare providers.

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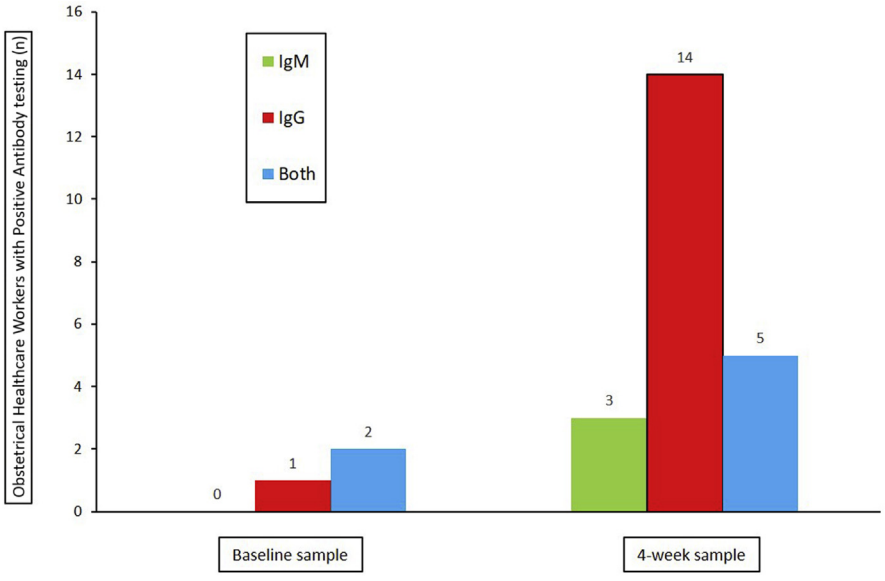
SUPPLEMENTAL FIGURE

Presence of SARS-CoV-2 antibodies at baseline and 4-week sample



IgG, immunoglobulin G; *IgM*, immunoglobulin M; *SARS-CoV-2*, severe acute respiratory syndrome coronavirus 2.

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SUPPLEMENTAL TABLE

Characteristics of obstetrical healthcare workers on the inpatient obstetrical unit

Demographics and outcome	n = 110
Median age (IQR)	34 (28.8–45.0)
Sex, n (%)	
Female	110 (100.0)
Male	0 (0.0)
Race and ethnicity, n (%)	
African American	10 (9.1)
White	95 (86.4)
Hispanic, other, or unknown	5 (4.5)
Position, n (%)	
Registered nurse	75 (68.2)
Physician	27 (24.5)
Nurse midwife	3 (2.7)
Unit clerk	2 (1.8)
Surgical technician	2 (1.8)
Ultrasound technician	1 (0.9)
COVID-19 exposure, n (%)	90 (81.8)
Work	90 (100.0)
Home	2 (1.8)
Any symptom, n (%)[a]	66 (60.0)
Headaches	51 (77.3)
Dry cough	31 (47.0)
Fever	17 (25.8)
Shortness of breath	24 (36.4)
Chest pain	12 (18.2)
Unexplained diarrhea	19 (28.8)
Loss of taste	16 (24.2)
Loss of smell	16 (24.2)
Runny nose	25 (37.9)
Sore throat	29 (43.9)
Congestion	24 (36.4)
Tested for SARS-CoV-2 (PCR), n (%)	52 (46.4)
Positive SARS-CoV-2 (PCR), n (%)	15 (13.6)
Quarantined, n (%)	20 (18.2)

Data are presented as median (IQR) or n (%).

COVID-19, coronavirus disease 2019; *IQR,* interquartile range; *PCR,* polymerase chain reaction; *SARS-CoV-2,* severe acute respiratory syndrome coronavirus 2.

[a] Some subjects reported more than 1 symptom.

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