



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief Report

Healthcare worker seroconversion for SARS-CoV-2 at two large health systems in San Diego



Laura Nicholson MD, PhD^{a,*}, Ronald W. McLawhon MD, PhD^b, Sunil Kurian PhD^c, Robert L. Fitzgerald PhD^b, Jamie Case PhD^c, Christopher Marsh MD^c, Michael Quigley MD^d

^a Scripps Clinic, Department of Medicine, La Jolla, CA

^b University of California San Diego Health, Department of Pathology, La Jolla, CA

^c Scripps Clinic, Department of Surgery, La Jolla, CA

^d Scripps Clinic, Department of Pathology, La Jolla, CA

Key Words:

Seroprevalence
COVID-19
Frontline providers

Coronavirus Disease 2019 infections among healthcare workers were widely reported in China and Europe as the pandemic expanded to the United States. In order to examine the infection rate among these essential workers, we combined results of SARS-CoV-2 serology testing offered free to healthcare workers at two large San Diego health systems when the antibody assays first became available.

© 2021 The Author(s). Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

INTRODUCTION

San Diego confirmed its first case of Coronavirus Disease 2019 (COVID-19) on March 9, 2020, 12 days after the first nontravel-related infection in the United States was diagnosed in California.¹ Personal protective equipment (PPE) was in limited supply at the onset of the pandemic, and occupational infections of healthcare workers (HCW) were increasingly reported.² While polymerase chain reaction (PCR) to detect viral nucleic acid is the mainstay for diagnosing acute COVID-19 disease, it has been intermittently reserved for only the most symptomatic individuals, particularly early in the outbreak. Thus PCR-positive case rates underrepresent the true penetrance of SARS-CoV-2 infection, and seroprevalence surveys allow for more accurate insight into population exposure.³ Additionally, in late winter 2020, multiple respiratory illnesses circulated in the population and many with mild symptoms believed they may have COVID-19 disease but were unable to obtain a test. Two large San Diego health systems offered SARS-CoV-2 serology tests free of charge for employees, in part to better illuminate workforce infection rates at sites caring for San Diego's early COVID-19 patients.

METHODS

Two multi-hospital San Diego healthcare systems offered free SARS CoV-2 IgG tests to their employees considered at risk for exposure – University of California San Diego Health (UCSD) invited 11,801 HCW beginning in April, and used Diazyme DZ-Lite 2019-nCoV IgG (CLIA) Assay on the DZ-Lite 3000 Plus, reporting 94.7% sensitivity and 99.1% specificity; Scripps Health invited 12,143 HCW beginning in May, using the Abbott Architect SARS-CoV-2 IgG assay, validating at 100% sensitivity and 99.6% specificity. Email invitations and flyers were distributed to workers in COVID-19 care areas, though confirmation of work area was not required at testing. Employees actively experiencing symptoms were asked not to participate in this screening and instead referred for clinical evaluation. All assays were conducted in certified clinical laboratories, and results were provided in accordance with Health Information Portability and Accountability Act regulations. De-identified results from the two health systems were combined in a posthoc analysis to provide a broader picture of HCW SARS-CoV-2 exposure early in the pandemic in San Diego County.

RESULTS

UCSD conducted 13,549 tests among 9,939 unique asymptomatic HCW between April 14 and July 28, 2020, and 97 (0.98%) were positive (Table 1). Scripps Health tested 2,054 HCW between May 27 and June 30, 2020, and 16 (0.78%) were positive. Combined, 113 of 11,993

* Address correspondence to Laura Nicholson, MD, PhD, Scripps Clinic Medical Group, 10666 North Torrey Pines Road, 404C, La Jolla, CA 92037.

E-mail address: Nicholson.Laura@scrippshealth.org (L. Nicholson).

Conflicts of Interest: The 7 authors listed above declare no conflict of interests related to this manuscript.

Table 1
Total number of SARS-CoV-2 IgG tests and positives in 2-week intervals at UCSD and Scripps

| Dates | Tests UCSD | Positives UCSD | Tests Scripps | Positives Scripps |
|----------------------|----------------|----------------|---------------|-------------------|
| Apr 14-30 | 1,715 | 9 | | |
| May 1-15 | 3,489 | 26 | | |
| May 16-31 | 2,760 | 14 | 189 | 1 |
| June 1-15 | 2,036 | 16 | 970 | 5 |
| June 16-30 | 1,734 | 19 | 895 | 10 |
| July 1-15 | 1,124 | 17 | | |
| July 16-28 | 691 | 12 | | |
| Totals (unique HCW)* | 13,549 (9,939) | 113 (97) | 2,054 (2,054) | 16 (16) |

*UCSD offered repeat serology testing among its HCW; Scripps offered only 1 serology test per HCW.

(0.94%) were positive across the two health systems. At UCSD, HCW roles were not specifically queried during testing. At Scripps, roles were surveyed with an open-ended question, and >400 unique responses were counted as 228 physicians, 734 nurses, and 1092 ancillary staff. Scripps' positives included 7 nurses, 2 hospital environmental services personnel, 1 surgeon, 1 physical therapist, 1 ultrasound technician, 1 patient care assistant, 1 food service worker, 1 transporter, and 1 information services technician.

DISCUSSION

San Diego County, the fifth most populated county in the United States, reported 29,577 PCR-confirmed COVID-19 cases as of July 31, among its 3.3 million populace.⁴ Conservatively assuming 6 unrecorded infections for each PCR-confirmed case produces an estimated community prevalence of 1.1% in late April rising to 5.4% by the end of July.^{3,4} Our HCW 0.94% seroprevalence collected across this time period indicates an occupational exposure very likely lower than the community infection rate, particularly given that a percentage, estimated at 5%–45% based on test characteristics, are expected to be falsely positive during the low April–July prevalence.

CONCLUSIONS

Reports from China, Europe, and New York led to the assumption that HCW SARS-CoV-2 occupational infection would be common and unavoidable in settings where care of COVID-19 patients takes place.^{5–7} Our results demonstrate that occupational COVID-19 infection risk is much lower in our setting than originally feared, even with clinical care limited to urgent and emergent illness before July. This leads to several conclusions. First, careful preparation of healthcare environments and workers allowed safe care of acutely ill COVID-19 patients. San Diego benefits from an engaged network of researchers and clinicians communicating to leaders regarding preparation for SARS-CoV-2-infected patients, leading to active training with PPE and prompt backup workforce planning before the first San Diego COVID-19 patient. Second, locking down March 19, early in the outbreak with fewer than 100 known San Diego cases, was effective in protecting frontline workers by preventing an overwhelmed healthcare environment, in contrast to areas with less forewarning and subsequent higher HCW seroconversion.⁸ Third, PPE works. Our HCW, consistently using PPE in the workplace, appear to have had a lower infection risk than the community as similarly reported elsewhere, providing strong evidence for the value of face masks and adherence to infection control measures in the general population.^{6,8} Finally, respiratory illnesses circulating in HCW at the start of San Diego's outbreak were predominantly not COVID-19, supported by the low HCW seropositivity rate in the first 150 days of San Diego's outbreak combined with the excellent specificity of these IgG assays, and consistent with reported retrospective sample testing.¹

In summary, our analysis illustrates a low infection rate and continued vulnerability among San Diego's healthcare workforce to the COVID-19 pandemic and affirms the need for adequate PPE, clinical staffing support, careful contact tracing, behavioral education, and vaccination when available. Limitations include different SARS-CoV-2 IgG assays and testing periods between the 2 centers, due to repeated postponement of available tests and their validation requirements, and the possibility that some HCW with early infections had become seronegative before assays were available. Additionally, our seroprevalence result may be an underestimate if previously confirmed (SARS-CoV-2 PCR+) HCW were less likely to seek antibody confirmation, or an overestimate if more HCW from higher risk work environments presented for participation. While COVID-19 patient contact or care location was not required to qualify for testing, many participants were working regularly in healthcare environments providing urgent, acute care while routine care was suspended. Lower seroprevalence in settings thus enriched for the presence of SARS-CoV-2, compared to community prevalence, provides important infection control information.

Acknowledgments

We would like to acknowledge the assistance of Rowena Carino, MA, Michelle Meyer, MSN, and Bethany Barrick, BS, in collecting, resulting, and compiling the serology assays.

References

1. CDC COVID-19 Response Team. Jordan MA, Rudman SL, Villarino E, et al. Evidence for limited early spread of COVID-19 within the United States, January–February 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69:680–684.
2. *One in 7 Reported COVID-19 Infections is Among Health Workers, WHO Says.* Reuters.com; 2020. September 17. Available at: <https://www.reuters.com/article/us-health-coronavirus-who-healthworkers/one-in-7-reported-covid-19-infections-is-among-health-workers-who-says-idUSKBN2681TR?il=0>. Accessed September 25, 2020.
3. Havers FP, Reed C, Lim T, et al. Seroprevalence of antibodies to SARS-CoV-2 in 10 sites in the United States, March 23–May 12, 2020. *JAMA Intern Med.* 2020;180:1576–1586.
4. County of San Diego Coronavirus Disease (COVID-19) Dashboard. Available at: <https://www.arcgis.com/apps/opsdashboard/index.html#/96feda77f12f46638b984fcb1d17bd24>. Accessed September 25, 2020.
5. Mansour M, Leven E, Muellers K, Stone K, Mendu DR, Wajnberg A. Prevalence of SARS-CoV-2 antibodies among healthcare workers at a tertiary academic hospital in New York City. *J Gen Intern Med.* 2020;35:2485–2486.
6. Steensels D, Oris E, Coninx L, et al. Hospital-wide SARS-CoV-2 antibody screening in 3056 staff in a tertiary center in Belgium. *JAMA.* 2020;324:195–197.
7. Xu X, Sun J, Nie S, et al. Seroprevalence of immunoglobulin M and G antibodies against SARS-CoV-2 in China. *Nat Med.* 2020;26:1193–1195.
8. *NY Frontline Workers Test Positive for Antibodies at Lower Rates than Rest of State.* NBCNewYork.com; 2020. Available at: <https://www.nbcnewyork.com/news/coronavirus/cuomo-ny-frontline-workers-test-positive-for-covid-antibodies-at-lower-rate-than-rest-of-state/2415595/>. Accessed September 25, 2020.