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Research Brief

Validation of Centers for Disease Control and Prevention level 3 risk classification for healthcare workers exposed to severe acute respiratory coronavirus virus 2 (SARS-CoV-2)

Candace M. Gragnani MD, MPH[1], Priyanka Fernandes MBBS, MPH[2] and Daniel A. Waxman MD, PhD[3]

[1]Department of Pediatrics, University of California–Los Angeles, Los Angeles, California, [2]Department of Medicine, University of California–Los Angeles, Los Angeles, California and [3]Department of Emergency Medicine, University of California–Los Angeles, Los Angeles, California

Experience from Wuhan, China, suggests that early identification and risk mitigation of healthcare workers (HCWs) potentially infected with coronavirus disease 2019 (COVID-19) is vital to preventing disease transmission in healthcare settings.[1] Early on, the Centers for Disease Control and Prevention (CDC) recommended furloughing HCWs with medium- and high-risk workplace exposures to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[2] They defined low-, medium-, and high-risk HCW exposures based on duration of close contact, presence of source control, and donning of personal protective equipment (PPE).[2] We evaluated the performance of the CDC classification scheme when applied prospectively early in community transmission.

Methods

UCLA Health is a large academic center with 2 acute-care hospitals, a psychiatric hospital, and many ambulatory sites. The study population included all UCLA Health employees with healthcare-related exposures between March 9 and March 27, 2020. During this interval, 357 patients tested positive for SARS-CoV-2 across UCLA Health sites, and 1,465 cases of COVID-19 were documented in Los Angeles County.[3] The infection prevention team was notified of all patients diagnosed with COVID-19 and was responsible for contact tracing, identifying potential employee exposure locations, and notifying unit supervisors and location managers at exposure locations. Supervisors and location managers would then (1) interview employees to confirm close contact (defined as <2 m for >3 minutes), (2) provide prospective CDC risk classification after an assessment of source control and employee PPE use, and (3) enroll them in a web-based symptom-tracking system. HCWs reporting symptoms were tested for SARS-CoV-2 at the physician's discretion.

We matched records from the postexposure tracking system to a consolidated report of SARS-CoV-2 polymerase chain reaction (PCR) test results to identify tested HCWs. The primary study outcome was a positive test within 14 days of exposure identification and notification. Untested HCWs and those tested after 14 days were treated as nonpositive. For HCWs with multiple exposures, the first instance of the highest risk exposure was used. We calculated the proportion with a positive PCR along with 95% confidence intervals (binomial, exact), and we determined the significance of the association between risk category and a positive result using the Fisher exact test. We obtained review and approval with waiver of consent from our institutional review board.

Results

In total, 753 HCWs were enrolled in postexposure monitoring. However, 45 HCWs were excluded from analysis because they had had SARS-CoV-2 testing between the date of exposure and enrollment, and 41 were excluded because the risk classification was missing. Population characteristics and outcomes are listed in Table 1. Of the 667 individuals included, exposure was classified as high risk for 98 (14.7%), medium risk for 192 (28.8%), and low risk for 377 (56.5%). Exposed HCWs were most commonly nurses (41.1%), and 71.7% of exposures occurred with inpatients (Table 1).

Overall, 321 HCWs (48.1%) were tested for SARS-CoV-2, and 24 (7.5%) were positive (Table 1). The Centers for Disease Control and Prevention (CDC) risk category was significantly associated with a positive test ($P < .01$). The proportions of HCWs with high-, medium-, and low-risk exposures diagnosed with COVID-19 were 9.2% (95% confidence interval [CI], 4.3%–16.7%), 4.7% (95% CI, 2.2%–8.7%), and 1.6% (95% CI, 0.6%–3.4%), respectively. This relationship remained significant ($P = .03$) when the analysis was restricted to the 321 HCWs tested.

Discussion

The CDC's 3-level risk classification was extrapolated from experience with other coronaviral infections including severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS).[4,5] In this study, we validated the CDC's initial exposure risk model for COVID-19, and we quantified the probability of infection by risk classification when applied prospectively in a real-world setting.

The 9.2% infection rate we observed among HCWs with high-risk exposure is consistent with previously published data.[6,7] However, our finding differs in demonstrating a full gradient of risk, with infection rates associated with medium-risk exposures intermediate between low- and high-risk groups. The observed

Author for correspondence: Candace M. Gragnani, E-mail: CGragnani@mednet.ucla.edu
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Table 1. Description of Healthcare Worker (HCW) Population with Centers for Disease Control and Prevention (CDC)–Risk Classified, Work-Related SARS-CoV-2 Exposures Enrolled in Symptom Monitoring (N=667)

		CDC Exposure Risk Level, No. (% of Risk Level)		
Variable	% Tested With PCR for SARS-CoV-2	High	Medium	Low
Population (N=667)	48.1	98	192	377
Age in y, Mean ± SD (N=576)		36.6±9.4	38.6±10.5	39.3±10.3
Sex (N=572)[a]				
Female (N=375)	53.3	53 (62.4)	110 (67.1)	212 (65.6)
Male (N=197)	41.6	32 (37.7)	54 (32.9)	111 (34.4)
Employee job description				
Nurse (N=274)	50.7	38 (38.8)	83 (43.2)	153 (40.6)
Resident physician (N=37)	67.6	5 (5.1)	12 (6.3)	20 (5.3)
Attending physician (N=47)	46.8	7 (7.1)	15 (7.8)	25 (6.6)
Respiratory therapist (N=28)	67.9	11 (11.2)	7 (3.7)	10 (2.7)
Other (clinical and support staff) (N=281)	41.3	37 (37.8)	75 (39.1)	169 (44.8)
Employee job site				
Inpatient (N=478)	50.8	82 (83.7)	140 (72.9)	256 (67.9)
Outpatient/other (N=189)	47.1	16 (16.3)	52 (27.1)	121 (32.1)
Days between exposure and enrollment, median [IQR] (N=667)		3 [2–6]	4 [3–6]	4 [2–7]
Days between enrollment and testing, median [IQR] (N=321)		3 [2–7]	4 [2–7]	4 [3–5]
Tested (N=321)		64 (65.3)	102 (53.1)	155 (41.1)
Outcome				
Positive COVID-19 PCR (N=24)[b]		9	9	6
As % of enrolled (95% CI)		9.2 (4.3–16.7)	4.7 (2.2–8.7)	1.6 (0.6–3.4)
As % of tested (95% CI)		14.1 (6.6–25.0)	8.8 (4.1–16.1)	3.9 (1.4–8.2)

NOTE. COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory coronavirus virus 2; PCR, polymerase chain reaction; SD, standard deviation; IQR, interquartile range; CI, confidence interval.
[a]% nonmissing.
[b]The Fisher exact tests for the association between risk category and a positive test in the exposed population and the tested population were $P = .001$ and $P = .028$, respectively.

"dose–response" between exposure severity and infection rates suggests a causal relationship during the study period.

This study has several limitations. Only 48% of the population was tested, and testing was more common after higher-risk exposures, which may have introduced bias. However, results were similar when only the subpopulation tested was considered. Also, although HCWs with high- and medium-risk exposures were initially furloughed, HCWs with low-risk exposures were allowed to continue working. This factor increased the risk of misattribution and may have biased the results toward the null hypothesis of no association. Finally, absolute infection rates represent an average across diverse facilities and might be different at specific facilities, according to environmental controls.

Notably, the CDC's subsequently revised guidance provides a simplified 2-level classification scheme grouping medium-risk exposures (source control but no HCW facemask or respirator, or no source control and no HCW eye protection) together with high-risk exposures. The minimum duration of close contact that meets exposure definition was changed from a "few minutes" to 15 cumulative minutes in a 24-hour period.[2,8] The importance of contact duration and distance in classifying exposure risk, in addition to the relative benefit of facemasks versus respirators and eye protection, remains unresolved.

Discrete, well-identified exposures to infected patients might not be the predominant risk to HCWs in the current high-prevalence environment, where HCW-to-HCW transmission, environmental contamination, and community-acquired disease play important roles. However, exposure risk stratification is likely to take on renewed importance as containment is achieved. Our study highlights the graded risk associated with varying exposure levels in the healthcare setting, which has important implications for workforce return. Our findings lend support to the CDC's decision to include exposures formerly classified as medium risk in the category to be considered for enhanced postexposure monitoring and work restrictions and highlights the need for further research.

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

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Occupational exposures in US obstetrics and gynecology resident physicians

Alison A. Garrett MD and Harold C. Wiesenfeld MD, CM

Department of Obstetrics, Gynecology and Reproductive Sciences, University of Pittsburgh School of Medicine and Magee-Womens Hospital of UPMC, Pittsburgh, Pennsylvania

Occupational exposures are defined as any exposure to body fluids that are potentially infectious during performance of healthcare duties; these include sharps injuries and mucous membrane exposures (MMEs). These events pose a risk of infection to providers and patients should transmission of an infectious agent occur. Providers of obstetrics and gynecology frequently perform procedures and are therefore at risk of experiencing occupational exposures. Procedures with high blood loss, common in obstetrics and gynecology, are associated with higher rates of occupational exposures.[1] Several studies document high rates of occupational exposures and infrequent reporting of injuries among surgical trainees; however, few obstetrics and gynecology resident physicians are represented in these reports.[2,3] We determined the self-reported frequency of occupational exposures and exposure reporting trends by US obstetrics and gynecology residents.

Methods

An online survey was circulated to leadership of all Accreditation Council for Graduate Medical Education (ACGME)-accredited obstetrics and gynecology residency programs requesting distribution to all resident physicians. Also, 3 reminders were sent over the following 6 weeks. The voluntary 22-item university institutional review board-approved survey remained open from May 1 through June 25, 2019. Consenting residents answered the survey and entered a raffle for a $50 e-gift card.

The survey was created using REDCap (Research Electronic Data Capture) tool, managed by the coordinating team at the University of Pittsburgh, and it was verified for comprehension. Physicians reported the total number of sharps injuries and MMEs experienced during residency and whether they reported the exposures to occupational health. Descriptive analyses used percentages, means, and medians. Variables were evaluated for significance by χ^2 test and analysis of variance (ANOVA). All P values were 2-sided. Demographics were compared to national ACGME information.[4]

Results

In total, 441 residents participated, representing 9% of the 4,716 residents in ACGME-accredited obstetrics and gynecology programs in 2019.[4] The mean age of respondents was 29.9 years, and 85.7% were women. In comparison, among US obstetrics and gynecology resident trainees in 2019, the mean age was 28.5 years and 82.8% were women. Of 441 respondents, 356 (80.7%) experienced at least 1 occupational exposure (Table 1). Sharps injuries were sustained by 322 residents (73.0%) and increased with years of training ($P < .01$). MMEs were sustained by 255 residents (57.8%) and also increased with years of training ($P < .01$). By the final year of training, 91% of residents experienced at least 1 sharps injury (mean, 3.29). The mean number of exposures did not differ by gender (4.3 for women vs 3.4 for men; $P = .25$), marital status (4.3 for

Author for correspondence: Alison A. Garrett, E-mail: garrettaa@upmc.edu

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