Validation of CDC 3-Level Risk Classification for Healthcare Workers Exposed to COVID-19

Abbreviated Title: Risk Stratifying Health Worker COVID Exposure

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Manuscript word count: 900
Introduction

Experience from Wuhan, China, suggests 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) (see reference, Table 1).\(^2\) Our study evaluates performance of the classification scheme when applied prospectively early in community transmission.

Methods

UCLA Health is a large academic center with two acute care hospitals, a psychiatric hospital, and many ambulatory sites. The study population includes all UCLA Health employees with healthcare-related exposures between March 9 and March 27, 2020. During this interval, there were 357 patients that tested positive for SARS-CoV-2 across UCLA Health sites and 1,465 cases of COVID-19 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/location managers at exposure locations. Supervisors/location managers would then: (1) interview employees to confirm close contact (defined as within six feet for more than three 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 COVID-19 at physician discretion.

We matched records from the post-exposure tracking system to a consolidated report of COVID-19 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 not-positive. For HCWs with multiple exposures, the first instance of the highest risk exposure was used. We report the proportion with a positive PCR along with 95% confidence intervals (binomial, exact), and test the significance of the association between risk category and a positive result (Fisher’s exact test). We obtained Institutional Review Board review and approval with waiver of consent.

**Results**

There were 753 HCWs enrolled in post-exposure monitoring: 45 were excluded from analysis for COVID-19 testing between the date of exposure and enrollment and 41 for missing risk classification. Population characteristics and outcomes are detailed in Table 1. Of the included 667 individuals, 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 inpatient (Table 1).

321 HCWs (48.1%) were tested for COVID-19, and 24 (7.5%) were positive (Table 1). CDC risk category was significantly associated with a positive test (p<.01). The proportion of HCWs with high-, medium-, and low-risk exposures diagnosed with COVID-19 were (respectively): 9.2%
This relationship remained significant (p=0.03) when the analysis was restricted to the 321 HCW 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). This study validates the CDC’s initial exposure risk model for COVID-19 and quantifies 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 exposures is consistent with previously published data. 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 “dose response” between exposure severity and infection rates suggests a causal relationship during the study timeframe.

There are several limitations to this study. Only 48% of the population was tested, and testing was more common after higher risk exposures, potentially introducing bias. However, results were similar when only the subpopulation tested was considered. Also, while HCWs with high- and medium-risk exposures were initially furloughed, HCWs with low-risk exposures were allowed to continue working. This would raise their risk of misattribution and bias results towards 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, CDC’s subsequently revised guidance provides a simplified two-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 and changed the minimum duration of close contact that meets exposure definition from a “few minutes” to 15 cumulative minutes in a 24-hour period. The importance of contact duration and distance in classifying exposure risk, in addition to the relative benefit of facemasks vs. 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 CDC’s decision to include exposures formerly classified as medium-risk in the category to be considered for enhanced post-exposure monitoring and work restrictions and highlights the need for further research.

**Acknowledgments**

**Financial support.** This research was supported by NIH National Center for Advancing Translational Science (NCATS) UCLA CTSI Grant Number UL1TR001881.

**Technical support.** We thank Martin Lai for offering his programming expertise to create the exposure tracking system. Study data were collected and managed using REDCap electronic data capture tools.

**Potential conflicts of interest.** All authors report no conflicts of interest relevant to this article.
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Table 1: Description of Healthcare Worker (HCW) Population with Centers for Disease Control and Prevention (CDC)-Risk Classified, Work-Related COVID-19 Exposures Enrolled in Symptom Monitoring (N=667)

| % tested with PCR for COVID-19 | CDC Exposure Risk Level, N(%) of risk level |
|--------------------------------|-------------------------------------------|
| 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                |
| Sexa (N=572)                  |                                           |                            |                            |
| 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%) |
|                      | 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] |
| Testing             | 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; PCR, polymerase chain reaction; y, years; SD, standard deviation; IQR, interquartile range; CI, confidence interval.

^a % non-missing

^b Fisher’s exact test for the association between risk category and a positive test in the exposed population and the tested population is p=0.001 and p=0.028, respectively.