*Infection Control & Hospital Epidemiology* (2021), 1–3
doi:10.1017/ice.2021.354

## Research Brief

# Coronavirus disease 2019 (COVID-19) risk among healthcare workers performing nasopharyngeal testing

Kevin L. Schwartz MD, MSc[1,2], Matthew P. Muller MD, PhD[1], Victoria Williams MPH[3], Robin Harry CIC[4], Sonya Booker MHA[1], Kevin Katz MD[4] and Jerome A. Leis MD, MSc[3,5]

[1]Unity Health Toronto, Toronto, Ontario, Canada, [2]Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada, [3]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada, [4]North York General Hospital, Toronto, Ontario, Canada and [5]Centre for Quality Improvement and Patient Safety, University of Toronto, Toronto, Ontario, Canada

(Received 4 June 2021; accepted 23 July 2021)

Severe acute respiratory coronavirus virus 2 (SARS-CoV-2) transmission occurs primarily via close contact.[1] There is some debate about the relative contribution of larger or smaller respiratory particles to this short-range transmission.[2] Whether surgical masks or N95 respirators are used by healthcare workers (HCWs) testing patients with suspected coronavirus disease 2019 (COVID-19) varies across different institutions.

In March 2020, COVID-19 assessment centers (CACs) were established throughout Ontario, Canada, and virtually all ambulatory nasopharyngeal testing for SARS-CoV-2 in the Province was conducted at these locations. Because COVID-19 is most infectious immediately prior to and shortly after the onset of symptoms, those cases diagnosed in the CACs, in which the median time from symptom onset to testing is ~2–4 days, are more infectious compared to patients seen later in their disease course.[3,4] We evaluated the risk of occupational COVID-19, and we assessed the effectiveness of the control measures implemented to protect HCWs in this high-risk setting.

We performed a multicenter cross-sectional study across four CACs in Toronto, Canada. Each CAC prospectively identified HCWs with COVID-19 between March 15, 2020, and March 14, 2021. All asymptomatic HCWs working in the CACs were required to undergo SARS-CoV-2 testing if they had unprotected close contact with anyone with COVID-19, if they traveled, or if they developed any symptoms whether minimal or atypical.[5] Each CAC implemented a standard hierarchy of controls[6] that focussed on potential points of transmission risk (Table 1). Those performing nasopharyngeal testing performed hand hygiene and wore surgical masks, eye protection, gown, and gloves according to Canadian recommendations. There were no changes in PPE recommendations during the study period. The primary outcome was the rate of CAC HCW positivity for SARS-CoV-2 compared to the rest of the Ontario population according to publicly reported rates. The secondary outcome was the number of CAC HCWs positive for SARS-CoV-2 who worked in a patient-facing role and regularly performed nasopharyngeal swabs or examine patients, compared to CAC HCWs (eg. administrative staff) who had no patient contact. The primary outcome was evaluated using the $\chi^2$ test. Based on our fixed sample size, using a 2-sided $\alpha$ of 0.05, we had a power of 80% to detect a difference of 2%. A Poisson regression model with a generalized estimating equation was created for the secondary analysis that accounted for clustering among HCWs at the same CAC. As a sensitivity analysis, the primary outcome was compared again based on a study period ending December 31, 2020, prior to the start of COVID-19 vaccination of HCWs. Research ethics review was not required because the study met criteria for exemption; the project was deemed improvement in quality and not human-subject research.

During the study period, 354,027 patients were tested across the 4 CACs, and 21,951 (6.2%) were confirmed positive for SARS-CoV-2, including 4,097 (4.3%), 2,830 (3.8%), 4,887 (5.8%) and 10,137 (10.1%) at the 4 CACs. Table 2 summarizes the outcomes of 470 HCWs working in the CACs. Overall HCW positivity rate for SARS CoV-2 was 2.3% (11 of 470) compared to 2.2% in the Ontario population ($P = .82$). We detected no significant difference in the rate of HCW infections between patient-facing and non–patient-facing roles, with 2.3% and 2.2% of HCWs positive, respectively (relative risk, 0.89; 95% confidence interval [CI], 0.49–1.65; $P = .72$). In the sensitivity analysis, the overall HCW positivity rate for SARS CoV-2 was 1.7% (8 of 470) compared to 1.2% in the rest of Ontario ($P = .34$).

Our results show that when embedded within a comprehensive bundle of measures designed to minimize COVID-19 transmission, the use of surgical masks was effective in protecting HCWs given a rate of infection similar to a population average that included nonessential workers. The similar infection rates between clinical and nonclinical staff suggest that most infections that did occur were likely acquired outside the CACs.

Variability in practice exists regarding whether surgical masks or N95 respirators are used for routine care of suspected or confirmed COVID-19 patients, including during testing for SARS-CoV-2. A recent systematic review reported limited to no evidence regarding the risk of aerosol transmission related to nasopharyngeal or oropharyngeal swabs in the detection of SARS-CoV-2.[9] Our study helps to address this important gap in the literature and supports existing

**Author for correspondence:** Jerome A. Leis, E-mail: Jerome.Leis@sunnybrook.ca
**Cite this article:** Schwartz KL, *et al.* (2021). Coronavirus disease 2019 (COVID-19) risk among healthcare workers performing nasopharyngeal testing. *Infection Control & Hospital Epidemiology*, https://doi.org/10.1017/ice.2021.354

**Table 1.** Hierarchy of Controls Implemented in COVID-19 Assessment Centers where 21,951 Patients Tested Positive for SARS-CoV-2 between March 15, 2020, and March 14, 2021

| |
|---|
| **Engineering controls** |
| – Assessment and optimization of HVAC system (see specific air exchanges) |
| **Administrative controls** |
| – Distancing of 2 m between patients upon entry to clinic and waiting room |
| – Partition at registration desk |
| – All nasopharyngeal testing in private room or behind partition |
| – Alcohol-based hand rub available at point of care |
| – Training of patient-facing staff in personal protective equipment donning and doffing and nasopharyngeal swab collection |
| – Environmental cleaning between patients |
| – Daily active screening of HCWs for symptoms, unprotected exposures and travel history with exclusion from work and testing when symptom positive and/or high risk exposure[a] |
| – Contact tracing of positive HCWs |
| – Distancing in break rooms |
| **Personal protective equipment** |
| Patient |
| – Masking at all times except during nasopharyngeal testing |
| Healthcare worker without patient contact |
| – Surgical mask |
| Healthcare worker performing nasopharyngeal testing |
| – Surgical mask |
| – Eye protection (face shield or goggles) |
| – Gown |
| – Gloves |

Note. HVAC, heating, ventilation and air conditioning; HCW, healthcare worker.
[a]High-risk exposure defined as any close contact (within 2 m) with unmasked individual for 10-minutes or longer where HCW was either not wearing a mask, or eye protection, or both.

**Table 2.** Number of Total and SARS-CoV-2–Positive Individuals Included In Study

| | | Patient-Facing HCWs | | Non–Patient-Facing HCWs | | Total | |
|---|---|---|---|---|---|---|---|
| Hospital Site | Average Air Changes per Hour in CAC | Total | Positive, No. (%) | Total | Positive, No. (%) | Population | Positive, No. (%) |
| 1 | 11 | 16 | 3(18.8) | 20 | 3(15.0) | 36 | 6 (16.7) |
| 2 | 3 | 143 | 2(1.4) | 51 | 0 | 194 | 2 (1.0) |
| 3 | 10 | 31 | 1(3.2) | 12 | 0 | 43 | 1 (2.3) |
| 4 | 6 | 121 | 1 (0.8) | 76 | 1 (1.3) | 197 | 2 (1.0) |
| All 4 CACs | | 311 | 7(2.3) | 159 | 4(2.5) | 470 | 11 (2.3) |
| Ontario | | . . . | . . . | . . . | . . . | 14,733,544 | 321,945 (2.2) |

Note. CAC, COVID-19 assessment center; HCW, healthcare worker.

international guidelines recommending droplet and contact precautions for this specimen collection.

This study has several limitations. It was limited by the observational design and small sample size. There were differences in the number of HCWs and the relative time working at each CAC, which may have affected the exposure risk between sites. We attempted to account for clustering within sites using generalized estimating equation model in the secondary analysis. The patient population had a test positivity rate of 6% and generally exposures during testing were brief. However, a detectable difference in SARS-CoV-2 infection risk would be expected if these practices were inadequate, given that these HCWs were within close contact to nearly 22,000 patients with COVID-19, have similar or higher expected nonoccupational risks for COVID-19 compared to the general population, and are more likely to be tested.[10]

Our findings provide supporting evidence for the effectiveness and safety of this combination of infection prevention and control measures, which includes PPE of a surgical mask, eye protection, gown, and gloves in the collection of nasopharyngeal and oropharyngeal swabs for SARS-CoV-2.

**Acknowledgments.** We thank staff working at the CAC, particularly in infection prevention and control and occupational health and safety, at all participating sites. We especially thank Nicholas Tomiczek of Sunnybrook Health Sciences Centre for helping to collate healthcare worker outcome data for this site.

**Financial support.** No financial support was provided relevant to this article.

**Conflicts of interest.** None of the authors have any conflicts of interest to disclose. Dr Jerome Leis has received remuneration outside of the present work, from the Ontario Hospital Association and Ministry of the Attorney General of Ontario for expert testimony regarding Infection Prevention and Control of COVID-19.

## References

1. How does COVID-19 spread between people? World Health Organization website. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19-how-is-it-transmitted. Published 2020. Accessed May 10, 2021.
2. Klompas M, Baker MA, Rheen C. Airborne transmission of SARS-CoV-2: theoretical considerations and available evidence. *JAMA* 2020;324: 441–442.

3. Paul LA, Daneman N, Brown KA *et al.* Characteristics associated with household transmission of SARS-CoV-2 in Ontario, Canada: a cohort study. *Clin Infect Dis* 2021. doi: 10.1093/cid/ciab186.
4. Johansson MA, Quandelacy TM, Kada S, *et al.* SARS-CoV-2 transmission from people without COVID-19 symptoms. *JAMA Network Open* 2021;4(1):e2035057.
5. Ontario Ministry of Health COVID-19 provincial testing guidance update v. 11.0. Ontario Ministry of Health website. https://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_testing_guidance.pdf. Accessed May 10, 2021.
6. The National Institute for Occupational Safety and Health (NIOSH). Hierarchy of controls. Centers for Disease Control and Prevention website. https://www.cdc.gov/niosh/topics/hierarchy/default.html. Accessed May 12, 2021.
7. Statistics Canada website. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000501. Accessed May 14, 2021.
8. Ontario COVID-19 case numbers. https://covid-19.ontario.ca/data. Government of Ontario website. Accessed May 14, 2021.
9. Agarwal A, Fernando SM, Honarmand K, *et al.* Risk of dispersion or aerosol generation and infection transmission with nasopharyngeal and oropharyngeal swabs for detection of COVID-19: a systematic review. *BMJ Open* 2021. doi: 10.1136/bmjopen-2020-040616.
10. Schwartz KL, Achonu C, Buchan SA, *et al.* Epidemiology, clinical characteristics, household transmission, and lethality of severe acute respiratory syndrome coronavirus-2 infection among healthcare workers in Ontario, Canada. *PLoS ONE* 2020;15(12):e0244477.