Article Type: Research Brief

COVID-19 risk among healthcare workers performing nasopharyngeal testing

Kevin L. Schwartz MD MSc, Matthew P. Muller MD PhD, Victoria Williams MPH, Robin Harry CIC, Sonya Booker MHA, Kevin Katz MD, Jerome A. Leis MD MSc

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

Corresponding Author: Jerome A. Leis, MD, MSc, FRCPC, Medical Director, Infection Prevention and Control, Sunnybrook Health Sciences Centre, Associate Professor, Department of Medicine, University of Toronto, 2075 Bayview avenue, Toronto, Ontario, M4N 3M5, Jerome.Leis@sunnybrook.ca, +1-416-480-4243

Keywords: COVID-19, occupational infection, Medical mask, aerosols, droplet and contact

Word Count: 862

Funding: No funding received.
SARS-CoV-2 transmission occurs primarily via close contact.\textsuperscript{1} There is some debate about the relative contribution of larger or smaller respiratory particles to this short-range transmission.\textsuperscript{2} Whether or not surgical masks or N95 respirators are used by healthcare workers testing patients with suspected COVID-19, varies across different institutions.

In March, 2020, COVID-19 Assessment Centres (CAC) were established throughout Ontario, Canada, and conducted virtually all ambulatory nasopharyngeal testing for SARS-CoV-2 in the Province. Because COVID-19 is most infectious immediately prior to and shortly after the onset of symptoms, those cases diagnosed in the CAC, where the median time from symptom onset to testing is approximately 2-4 days, are more infectious compared to patients seen later in their disease course.\textsuperscript{3,4} We sought to evaluate the risk of occupational COVID-19 and to assess the effectiveness of the control measures implemented to protect healthcare workers (HCW) 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 15 March, 2020 and 14 March, 2021. All asymptomatic HCWs working in the CACs were required to undergo SARS-CoV-2 testing if they had an unprotected close contact with anyone with COVID-19, travel, or if they developed any symptoms whether minimal or atypical.\textsuperscript{5} Each CAC implemented a standard hierarchy of controls\textsuperscript{6} that focussed on potential points of transmission risk (Table 1). Those performing nasopharyngeal testing performed hand hygiene and wore a surgical mask, eye protection, gown and gloves as per 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 as 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 work in a patient-facing role and regularly perform nasopharyngeal swabs or examine patients, as compared to CAC HCWs (eg. administrative staff) who have no patient contact. The primary outcome was evaluated using a chi-squared test. Based on our fixed sample size, using a two-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 31 December, 2020, prior to the start of COVID-19 vaccination of HCWs. Research ethics review was not required.
because the study met criteria for exemption as the project was deemed improvement in quality and not human subject research.

During the study period 354,027 patients were tested across the four 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 four CACs, respectively. Table 2 summarizes the outcomes of 470 HCWs working in the CACs. Overall HCW positivity for SARS CoV-2 was 2.3% (11/470) as compared to 2.2% in the Ontario population (p=0.82). There was no significant difference observed 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% CI 0.49-1.65, p=0.72). In the sensitivity analysis, the overall HCW positivity for SARS CoV-2 was 1.7% (8/470) as compared to 1.2% in the rest of Ontario (p=0.34).

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 non-essential workers. The similar infection rates between clinical and non-clinical staff suggests that most infections that did occur were likely acquired outside of the CACs.

Variability in practice exists regarding whether or not 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 found limited to no evidence regarding the risk of aerosol transmission related to nasopharyngeal or oropharyngeal swabs in the detection of SARS-Cov-2. Our study helps to address this important gap in the literature and supports existing international guidelines recommending droplet and contact precautions for this specimen collection.

This study is 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 impact 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 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 non-occupational risks for COVID-19 compared to the general population, and are more likely to be tested.\textsuperscript{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.

**Acknowledgment**

We thank staff working at the CAC, Infection Prevention and Control and Occupational Health and Safety at all participating sites. A special thanks to Nicholas Tomiczek of Sunnybrook Health Sciences Centre for helping to collate healthcare worker outcome data for this site.

**Conflict of interest and financial statement**

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.
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Table 1. Hierarchy of controls implemented in COVID-19 Assessment Centres where 21,951 patients tested positive 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 metres (6 feet) 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* |
| - 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                                                                             |

HVAC = heating, ventilation and air conditioning; HCW = healthcare worker; *high risk exposure defined as any close contact (within 6 feet) 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

| Hospital site | Average Air Changes per hour in CAC | Patient Facing HCWs | Non Patient Facing HCWs | Total |
|---------------|-------------------------------------|---------------------|-------------------------|-------|
|               | Total | Positive (%) | Total | Positive (%) | Population | Positive (%) |
| 1             | 11    | 16          | 20   | 3(15.0)     | 36        | 6(16.7)     |
| 2             | 3     | 143         | 51   | 2(1.4)      | 194       | 2(1.0)      |
| 3             | 10    | 31          | 12   | 1(3.2)      | 43        | 1(2.3)      |
| 4             | 6     | 121         | 76   | 1 (1.3%)    | 197       | 2 (1.0)     |
| All 4 CACs    | 311   | 7(2.3)      | 159  | 4(2.5)      | 470       | 11(2.3)     |

CAC = COVID-19 Assessment Centre; HCW = healthcare worker

Ontario       - - - - 14,733,544 321,945 (2.2%)