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Research

SARS-CoV-2 testing, infection and outcomes among Ontario physicians: a descriptive population-based cohort study

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Abstract

Background: Health care workers have a higher risk of acquiring SARS-CoV-2 infection than the general population. Our study reports on SARS-CoV-2 testing, infection and associated outcomes in Ontario physicians before SARS-CoV-2 vaccination became available on Dec. 14, 2020.

Methods: We conducted a descriptive, population-based cohort study of physicians in Ontario, Canada, from Jan. 25 to Dec. 31, 2020. We included physicians and postgraduate medical trainees who were residents of Ontario and registrants with the College of Physicians and Surgeons of Ontario during the study period. We examined the proportion of physicians tested for SARS-CoV-2 infection, the proportion who tested positive, and how testing and infections varied by certain physician characteristics. We reported on clinical outcomes associated with infection, including hospital admission and death.

Results: Of 41 208 physicians (mean age 47 yr; 56.1% male), 19 116 (46.4%) were tested at least once for SARS-CoV-2 infection; 358 tested positive (0.9%). No physicians died within 30 days of testing positive; however, 20/358 (5.6%) were admitted to hospital. By specialty, the proportion tested was highest among postgraduate medical trainees (2531/4125 [61.4%]), emergency physicians (281/478 [58.8%]), infectious disease physicians (33/67 [49.3%]) and family physicians (8857/18 553 [47.7%]). The proportion who tested positive was highest among internal medicine physicians (44/3499 [1.3%]), postgraduate medical trainees (47/4125 [1.1%]) and family physicians (171/18 553 [0.9%]). Of 2290 physicians who worked in long-term care, 1636 (71.4%) were tested and 25 (1.1%) tested positive.

Interpretation: During the prevaccination period of the COVID-19 pandemic in Ontario, nearly half of all physicians in the province were tested at least once for SARS-CoV-2 infection, 0.9% tested positive and none died. These findings may reflect the public health measures that were implemented in the province during this period.

Health care workers have a higher risk of acquiring SARS-CoV-2 infection than the general population.[1,2] Worldwide, the reported prevalence of SARS-CoV-2 infection among health care workers varies widely.[3–8] Numerous factors influence these estimates, including methods of ascertaining SARS-CoV-2 infection, access to personal protective equipment and the regional and community prevalence of SARS-CoV-2. In a systematic review of studies published in 2020, the estimated prevalence of laboratory-confirmed SARS-CoV-2 infection in health care workers was 11% (95% confidence interval [CI] 7%–15%).[3] In Canada, 1 report suggested that as of January 2021, nearly 10% of all recorded infections had occurred in health care workers;[9] however, information on infection rates and outcomes among different types of health care workers was not reported.

Our objective was to describe trends in SARS-CoV-2 testing and infection among Ontario physicians during the prevaccination period of the pandemic. We examine the proportion of physicians tested for SARS-CoV-2 infection, the proportion testing positive, and how testing and infections varied by certain physician characteristics. We also report on clinical outcomes associated with infection, including hospital admission and death.

Methods

Study design and setting

We conducted a descriptive, population-based cohort study of physicians in Ontario, Canada, using linked administrative health care databases housed at ICES. The study period was from Jan. 25, 2020 (date of the first presumptive case of

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SARS-CoV-2 infection in Ontario[10]) to Dec. 31, 2020. SARS-CoV-2 vaccination of health care workers began on Dec. 14, 2020.[11]

The study period encompassed the first pandemic wave in Ontario and part of the second wave — defined by Public Health Ontario as Feb. 26, 2020, to Aug. 31, 2020, and Sept. 1, 2020, to Feb. 28, 2021, respectively.[12] For context, of all cases of SARS-CoV-2 infection in Ontario up until Sept. 30, 2021, the proportion of patients admitted to hospital was highest in wave 1, as was the proportion of deaths;[12] 34% of long-term care homes experienced an outbreak in wave 1 (i.e., at least 1 resident case), and resident deaths accounted for 64% of all deaths.[13] Governmental responses during wave 1 included declaration of a state of emergency, closure of public schools and facilities, restriction of travel between Canada and the United States, and shutdown of nonessential businesses.[10]

We followed Reporting of Studies Conducted Using Observational Routinely-Collected Data (RECORD) guideline to structure our report.[14]

Participants

To practise medicine in Ontario, physicians must register with the College of Physicians and Surgeons of Ontario (CPSO). We included all physicians and postgraduate medical trainees (i.e., residents and fellows) who were registered with the CPSO as of Jan. 25, 2020, and also new registrants until Aug. 17, 2020. We defined the study entry date as Jan. 25, 2020, for physicians registered in CPSO by this date, and for those who registered after Jan. 25, 2020, we used the CPSO registration date instead. We excluded out-of-province physicians (place of residence was determined using the Registered Persons Database) and physicians who had not accessed Ontario Health Insurance Plan (OHIP)–insured services for their own care for 5 years or more. We also excluded physicians with missing identifiers (e.g., age or sex).

Data sources

A data-sharing agreement between ICES and CPSO enabled data linkages using uniquely encoded identifiers. Detailed information on the study databases and variables is provided in Appendix 1, e-Tables 1, 2 and 3 (available at www.cmajopen.ca/content/10/3/E657/suppl/DC1). Briefly, we obtained information on hospital and ambulatory care from the Canadian Institute for Health Information Discharge Abstract Database[15] and the National Ambulatory Care Reporting System.[16] We obtained physician service claims from the OHIP Claims Database.[17] We obtained SARS-CoV-2 test results from the COVID-19 Integrated Testing Database, which is an ICES-generated data set that includes diagnostic laboratory results from the Ontario Laboratory Information System, distributed testing data from laboratories within the COVID-19 Diagnostic Network and additional data from the Public Health Case and Contact Management Solution.[18] We obtained demographics and vital status from the Registered Persons Database (RPDB).[19] All analyses were done at ICES.

Variables and outcomes

Baseline physician characteristics

We obtained residential locations for physicians using postal code information from RPDB and grouped by Local Health Integration Network regions as defined by the Ontario Ministry of Health (Appendix 1, e-Table 2).[20] We categorized specialties using the "primary specialty" data from CPSO, which also listed subspecialty-trained physicians under their respective subspecialties. If a physician's specialty was missing in CPSO (about 23%), our statistician (E.M.) attempted to determine their specialty based on variables in the ICES Physician Database (IPDB) and the OHIP Claims Database. If specialty information remained missing (suggestive of no billing for patient encounters) and the physician's medical school graduation year was 2015 or later, they were classified as a "postgraduate medical trainee"; we chose 2015 to identify trainees as most residency programs, aside from family medicine (generally 2 years), require 5 years of training. Provision of care in a long-term care home was determined using the OHIP claim location associated with each physician–patient encounter. We computed the physicians' Charlson Comorbidity Index[21] at baseline using all hospital admission records in the 5-year period before the study entry date (a higher score indicates greater comorbidity).

SARS-CoV-2 testing

We examined the number of physicians tested at least once for SARS-CoV-2 infection between Jan. 25, 2020, and Nov. 30, 2020; we chose the latter date to allow for adequate follow-up before the study end date on Dec. 31, 2020. We obtained SARS-CoV-2 test data from provincial laboratory databases; all tests were nucleic acid amplification tests.[22] We report the number of physicians who had a positive test (considering their first test only), a subsequent negative test and how many were tested more than once. The proportion with a subsequent negative test is reported before and after May 2, 2020, when Ontario shifted from a test-based approach (2 consecutive negative tests collected at least 24 hr apart) to a time-based approach (waiting 14 d from a positive test) for clearing cases.[23] Furthermore, on May 31, 2020, bi-weekly testing was mandated for workers in long-term care homes,[24] which changed to weekly testing in hotspots on Nov. 22, 2020.[25] We therefore stratified our data by these time periods.

Among physicians who tested positive for SARS-CoV-2 infection, we recorded the setting where the test was done. Using OHIP billing codes (Appendix 1, e-Table 3), we determined whether physicians had provided in-person patient care in the week before their positive test date, and whether a patient they cared for had had a positive test. All OHIP claims not associated with a "virtual care" fee code were considered in-person; we obtained patients' SARS-CoV-2 test results from the COVID-19 Integrated Testing Database. We used a week-long time frame, given that the mean incubation period of SARS-CoV-2 is reported to be 4.2 to 6.7 days.[26]

Clinical outcomes

We assessed whether the following clinical outcomes occurred within 30 days of a physician's positive test: all-cause mortality, hospital admission, intensive care unit (ICU) admission, receipt of mechanical ventilation and receipt of acute dialysis. If a positive test was obtained during a hospital or ICU admission, we counted these outcomes as present. The 30-day follow-up period was used in previous studies evaluating SARS-CoV-2 infections.[27,28] We examined receipt of acute dialysis because this outcome has been reported in 6.8% of patients with SARS-CoV-2,[29] and the development of acute kidney injury from SARS-CoV-2 infection is associated with a 13-fold higher risk of mortality.[30]

Statistical analysis

Study variables were summarized as counts and proportions, means and standard deviations (SDs), or medians and interquartile ranges (IQRs), as appropriate. Missing data are presented and analyzed independently in the same manner as other categories. We report the proportion of physicians tested for SARS-CoV-2 infection and the proportion testing positive descriptively, by physician characteristics. We performed all analyses using SAS version 9.4 (SAS Institute, Cary, NC).

Ethics approval

This study was approved by the Health Sciences Research Ethics Board at Western University in London, Ontario, Canada. ICES is an independent, nonprofit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement.

Results

The study cohort included 41 208 physicians (Figure 1). Baseline characteristics are shown in Table 1. The mean age of physicians was 46.6 years (SD 14) and 56.1% were men; 95.3% lived in an urban setting, 24.1% resided in the Toronto Central region, 45.0% specialized in family medicine and 5.6% provided care in a long-term care home. In terms of baseline health, 38.2% of physicians had had at least 1 hospital admission within the past 5 years, and 88.5% of those with at least 1 hospital admission had a score of 0 on the Charlson Comorbidity Index.

SARS-CoV-2 testing

During the study period, 19 116 of 41 208 physicians (46.4%) had at least 1 SARS-CoV-2 test, 9033 (21.9%) had multiple tests, and 358 of 41 208 (0.9%) had at least 1 positive test result (1.9% of 19 116 physicians tested) (Table 2). The pattern of SARS-CoV-2 testing and infections over time is shown in Figure 2. Of 358 physicians who tested positive, 14.0% were tested in an emergency department visit and fewer than 1.7% during a hospital admission (exact numbers not reported for confidentiality).

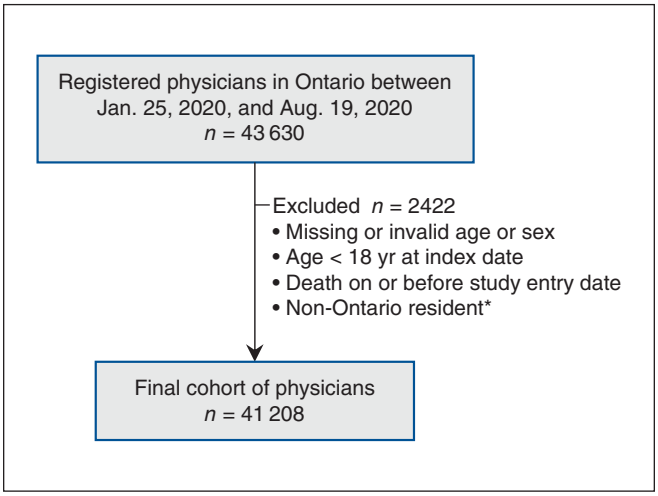

Figure 1: Physician cohort build. *Physicians whose permanent address was outside of Ontario were considered to be non-Ontario residents. The province where a person's permanent address is located is encoded by the first 2 digits of the variable "prcddablk" in the Registered Persons Database, and the first 2 digits, "35," represent Ontario. If data for this variable were missing or if the first 2 digits were not 35, the physician was considered to be a non-Ontario resident. Similarly, physicians with no registered health care services in the previous 5 years were considered to be non-Ontario residents.

A subsequent negative SARS-CoV-2 test was recorded for 110 of 358 (30.7%) physicians, and the median time from the first positive test to the negative test was 17 days (IQR 12–30). We also found that 67.5% (83/123) of physicians with SARS-CoV-2 infection had a negative test recorded within 30 days of their positive test before or on May 2, 2020 (when the test policy changed). After this date, 11.1% (26/235) had a negative test recorded within 30 days of their positive test.

Among 358 physicians who tested positive, 243 (67.9%) provided in-person patient care the week before the positive test date; 78 physicians (21.8%) provided care to a patient with SARS-CoV-2 infection during this time frame.

Variation in SARS-CoV-2 testing and test results by physician characteristics are shown in Table 2. Within age groups, the proportion tested was highest in those younger than 40 years (8707/15 956 [54.6%]) and lowest in those aged 60 years or older (3218/8830 [36.4%]). By residential location, the proportion tested ranged from a high of 358/592 (60.5%) in the North West to a low of 410/1121 (36.6%) in Erie St. Clair. By specialty, the proportion tested was highest among postgraduate medical trainees (2531/4125 [61.4%]), emergency physicians (281/478 [58.8%]), infectious disease physicians (33/67 [49.3%]) and family physicians (8857/18 553 [47.7%]).

Within age groups, the proportion testing positive was highest in those younger than 40 years (167/15 956[1.1%]) and lowest in those aged 40–59 years (123/7191 [0.7%]). By specialty, the incidence of a positive test result was highest among internal medicine physicians (44/3499 [1.3%]), postgraduate medical trainees (47/4125 [1.1%]) and family physicians (171/18 553 [0.9%]).

Table 1 (part 1 of 2): Baseline characteristics of 41 208 physicians who practised in Ontario in 2020

Characteristic	No. (%)* of physicians *n* = 41 208
Age, yr, mean ± SD	46.6 ± 14.1
< 40	15 956 (38.7)
40–59	16 422 (39.9)
≥ 60	8830 (21.4)
Sex	
Male	23 102 (56.1)
Female	18 106 (43.9)
Residence†	
Urban	39 265 (95.3)
Rural	1758 (4.3)
Missing	185 (0.4)
Local Health Integration Network‡	
Toronto Central	9934 (24.1)
Central	5323 (12.9)
Champlain	5185 (12.6)
Hamilton Niagara Haldimand Brant	4292 (10.4)
Mississauga Halton	3372 (8.2)
South West	3343 (8.1)
South East	1868 (4.5)
Central East	1774 (4.3)
Waterloo Wellington	1441 (3.5)
North East	1251 (3.0)
Erie St. Clair	1121 (2.7)
North Simcoe Muskoka	974 (2.4)
Central West	738 (1.8)
North West	592 (1.4)
Specialty	
Family medicine	18 553 (45.0)
Surgical	4393 (10.7)
Internal medicine	3499 (8.5)
Anesthesia	1295 (3.1)
Emergency	478 (1.2)
Cardiology	363 (0.9)
Infectious diseases	67 (0.2)
Postgraduate medical trainee	4125 (10.0)
Other specialty	6462 (15.7)
Missing	1973 (4.8)
Provided care in a long-term care home	
No	38 918 (94.4)
Yes	2290 (5.6)

Table 1 (part 2 of 2): Baseline characteristics of 41 208 physicians who practised in Ontario in 2020

Characteristic	No. (%)* of physicians *n* = 41 208
Medical school location	
Canada	27 479 (66.7)
International	13 729 (33.3)
Years since medical school graduation, mean ± SD	20.6 ± 14.3
Hospital admissions§	
≥ 1	15 750 (38.2)
Charlson Comorbidity Index§	
Mean score ± SD	0.1 ± 0.5
0	13 942 (88.5)
≥ 1	1808 (11.5)

Note: CPSO = College of Physicians and Surgeons of Ontario, SD = standard deviation.
*Unless otherwise specified.
†Rural defined as residing in a location with a population of < 10 000 individuals.
‡Residence within Local Health Integration Network regions as defined by the Ontario Ministry of Health. Physician's residential location may not coincide with their practice location. For a map, see https://www150.statcan.gc.ca/n1/pub/82-003-x/2015003/article/14144/c-g/fig1-eng.htm.
§Calculated using all hospital admission records in the 5-year period before the study entry date. We defined the study entry date as Jan. 25, 2020, for physicians registered in CPSO by this date, and for those who registered after Jan. 25, 2020, the CPSO registration date was used as the study entry date.

Of 2290 physicians who provided care to a patient in a long-term care setting, 1636 (71.4%) were tested and 25 (1.0%) tested positive; 786 (34.3%) were tested before May 31, 2020; 1459 (63.7%) between May 31 and Nov. 21, 2020; and 638 (27.9%) between Nov. 22 and Dec. 31, 2020. The temporal trend of SARS-CoV-2 testing in physicians who provided care in long-term care settings versus non-long-term care settings is shown in Figure 3.

Clinical outcomes

Of 358 physicians who tested positive, 20 (5.6%) were admitted to hospital, either at the time of test completion or during the ensuing 30 days. An ICU admission was recorded for 1.7% of those who tested positive and fewer than 1.7% required mechanical ventilation. No physicians received dialysis and no physicians died.

Interpretation

In 2020, almost half of all physicians in Ontario were tested at least once for SARS-CoV-2 infection and 0.9% tested positive (1.9% of those tested). Of 358 who tested positive, 5.6% were admitted to hospital within 30 days and no physicians died.

The proportion of physicians tested and the proportion testing positive was highest in those younger than 40 years, which may reflect that early in the pandemic, some older physicians were taken off front-line duty, given evidence of

Table 2 (part 1 of 2): SARS-CoV-2 testing and infection in 41 208 physicians who practised in Ontario in 2020

Characteristic	No. of physicians	No. (row %) of physicians tested	No. (row %) of physicians who tested positive	Proportion of total physicians *n* = 41 208	Proportion of physicians tested *n* = 19 116	Proportion of physicians testing positive *n* = 358
Overall	41 208	19 116 (46.4)	358 (0.9)			
Age, yr						
< 40	15 956	8707 (54.6)	167 (1.0)	38.7	45.5	46.6
40–59	16 422	7191 (43.8)	123 (0.7)	39.9	37.6	34.4
≥ 60	8830	3218 (36.4)	68 (0.8)	21.4	16.8	19.0
Sex						
Male	23 102	9995 (43.3)	213 (0.9)	56.1	52.3	59.5
Female	18 106	9121 (50.4)	145 (0.8)	43.9	47.7	40.5
Residence*						
Urban	39 265	18 127 (46.2)	≥ 352 (≥ 0.9)	95.2	94.8	≥ 98.3
Rural	1758	908 (51.6)	< 6 (< 0.3)	4.3	4.7	< 1.7
Missing	185	81 (43.8)	0 (0)	0.4	0.4	0
Local Health Integration Network†						
Toronto Central	9934	5088 (51.2)	112 (1.1)	24.1	26.6	31.3
Central	5323	2248 (42.2)	50 (0.9)	12.9	11.8	14.0
Champlain	5185	2399 (46.3)	28 (0.5)	12.6	12.5	7.8
Hamilton Niagara Haldimand Brant	4292	1983 (46.2)	40 (0.9)	10.4	10.4	11.2
Mississauga Halton	3372	1551 (46.0)	42 (1.2)	8.2	8.1	11.7
South West	3343	1593 (47.7)	19 (0.6)	8.1	8.3	5.3
South East	1868	712 (38.1)	< 6 (< 0.3)	4.5	3.7	< 1.7
Central East	1774	781 (44.0)	18 (1.0)	4.3	4.1	5.0
Waterloo Wellington	1441	635 (44.1)	18 (1.2)	3.5	3.3	5.0
North East	1251	626 (50.0)	< 6 (< 0.5)	3.0	3.3	< 1.7
Erie St. Clair	1121	410 (36.6)	9 (0.8)	2.7	2.1	2.5
North Simcoe Muskoka	974	433 (44.5)	7 (0.7)	2.4	2.3	2.0
Central West	738	299 (40.5)	9 (1.2)	1.8	1.6	2.5
North West	592	358 (60.5)	< 6 (< 1.0)	1.4	1.9	< 1.7
Specialty						
Family medicine	18 553	8857 (47.7)	171 (0.9)	45.0	46.3	47.8
Surgical	4393	1679 (38.1)	22 (0.5)	10.7	8.8	6.1
Internal medicine	3499	1625 (46.4)	44 (1.3)	8.5	8.5	12.3
Anesthesia	1295	596 (46.0)	6 (0.5)	3.1	3.1	1.7
Emergency	478	281 (58.8)	< 6 (< 1.3)	1.2	1.5	< 1.7
Cardiology	363	161 (44.4)	< 6 (< 1.7)	0.9	0.8	< 1.7
Postgraduate medical trainee	4125	2531 (61.4)	47 (1.1)	0.1	13.2	13.1
Infectious diseases	67	33 (49.3)	< 6 (< 9.0)	0.2	0.2	< 1.7
Other specialty	6462	2516 (38.9)	≥ 36 (≥ 0.6)	15.7	13.2	≥ 10.1
Missing	1973	837 (42.4)	14 (0.7)	4.8	4.4	3.9

Table 2 (part 2 of 2): SARS-CoV-2 testing and infection in 41 208 physicians who practised in Ontario in 2020

Characteristic	No. of physicians	No. (row %) of physicians tested	No. (row %) of physicians who tested positive	Proportion of total physicians *n* = 41 208	Proportion of physicians tested *n* = 19 116	Proportion of physicians testing positive *n* = 358
Provided care in a long-term care home						
No	38 918	17 480 (44.9)	333 (0.9)	94.4	91.4	93.0
Yes	2290	1636 (71.4)	25 (1.1)	5.6	8.6	7.0
Medical school location						
Canada	27 479	13 440 (48.9)	230 (0.8)	66.7	70.3	64.2
International	13 729	5676 (41.3)	128 (0.9)	33.3	29.7	35.8
Hospital admissions‡						
≥ 1	15 750	7735 (49.1)	133 (0.8)	38.2	40.5	37.2
Charlson Comorbidity Index score‡						
0	13 942	6975 (50.0)	119 (0.9)	88.5	90.2	89.5
≥ 1	1808	760 (42.0)	14 (0.8)	11.5	9.8	10.5

Note: CPSO = College of Physicians and Surgeons of Ontario, SD = standard deviation.
*Rural was defined as residing in a location with a population of < 10 000 individuals.
†Residence within Local Health Integration Network regions as defined by the Ontario Ministry of Health. Physician's residential location may not coincide with their practice location. For a map, see https://www150.statcan.gc.ca/n1/pub/82-003-x/2015003/article/14144/c-g/fig1-eng.htm.
‡Calculated using all hospital admission records in the 5-year period before study entry date. The study entry date was defined as Jan. 25, 2020, for physicians registered in CPSO on or before this date, and it was defined as the CPSO registration date for those who entered the cohort after this date.

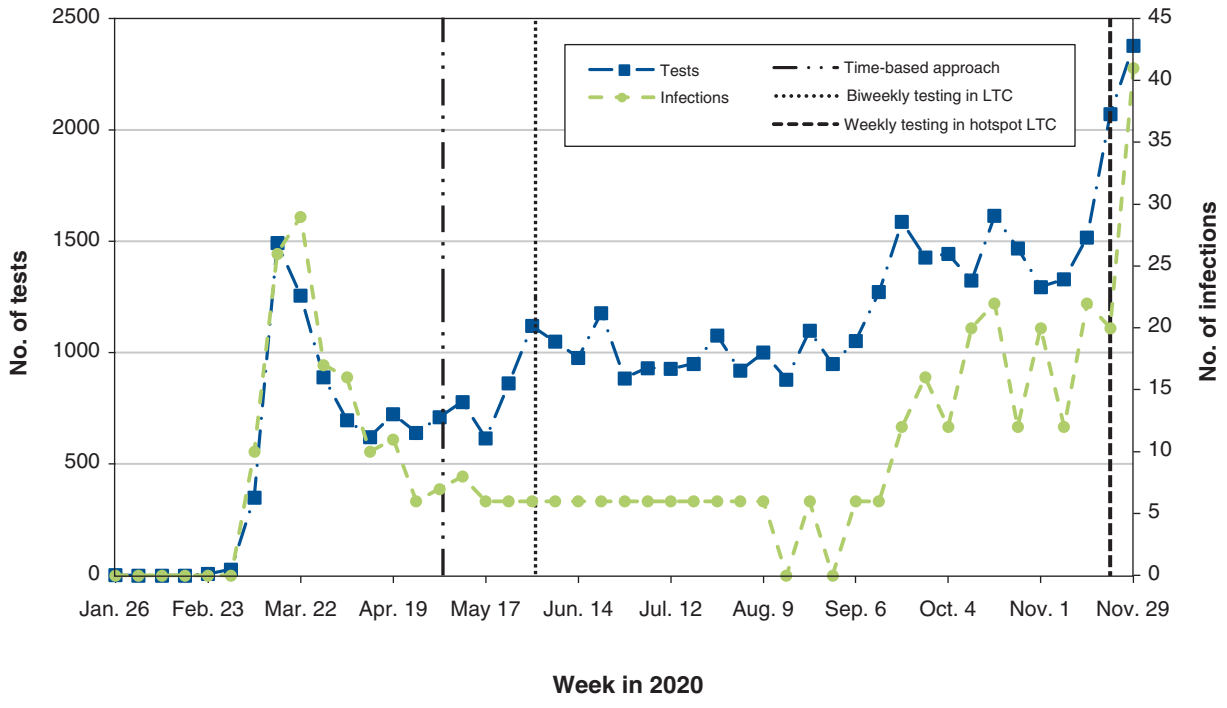

Figure 2: Trends in SARS-CoV-2 testing and infection during the study period. Note: On May 2, 2020, Ontario shifted from a test-based approach (2 consecutive negative tests collected at least 24 hr apart) to a time-based approach (waiting 14 d from a positive test) for clearing cases.[23] Biweekly testing was mandated for workers in long-term care (LTC) homes on May 31, 2020,[24] which changed to weekly testing in hotspots on Nov. 22, 2020.[25]

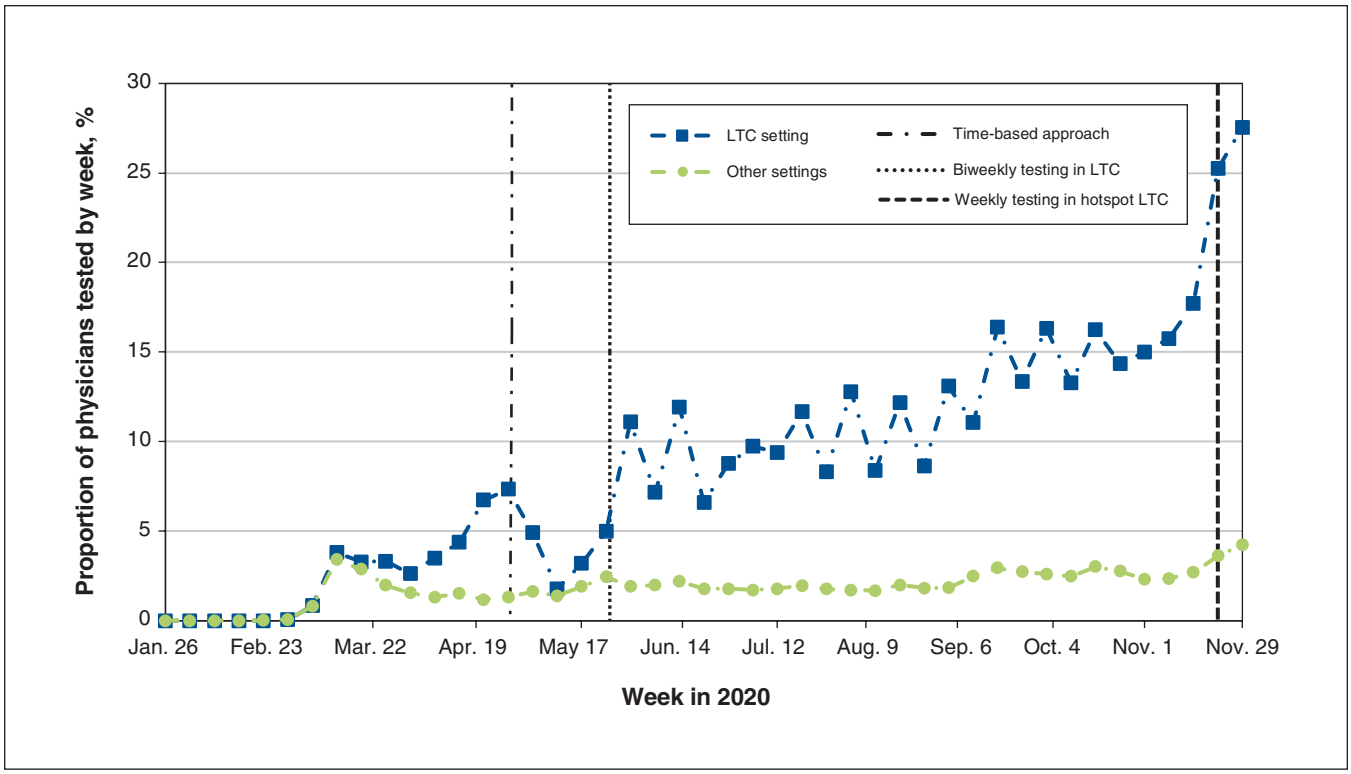

Figure 3: Testing for SARS-CoV-2 infection among physicians who provided care in long-term care (LTC) settings versus other settings, by week. Note: On May 2, 2020, Ontario shifted from a test-based approach (2 consecutive negative tests collected at least 24 h apart) to a time-based approach (waiting 14 d from a positive test) for clearing cases.[23] Biweekly testing was mandated for workers in LTC homes on May 31, 2020,[24] which changed to weekly testing in hotspots on Nov. 22, 2020.[25]

higher infection severity and mortality with older age.[31,32] By specialty, the proportion tested was highest among postgraduate medical trainees (61.4%), emergency physicians (58.8%), infectious disease physicians (49.3%) and family physicians (47.7%). In long-term settings, nearly three-quarters (71.4%) of physicians who worked there were tested. Weekly testing rates in physicians in long-term care versus other settings diverged substantially after May 31, 2020, when biweekly testing in long-term care settings was mandated.[24] By specialty, the proportion testing positive was highest among internal medicine physicians (1.3%) and lowest among surgeons (0.5%), which may reflect differences in exposure and policy changes (reduction and cancellation of elective surgeries) that occurred during the first wave.[33]

In studies conducted in other countries, the reported proportion of physician infections among health care workers has ranged from 10% to 65%.[3,34–38] However, not all reports were peer reviewed, some were published on preprint servers, and methods of ascertaining SARS-CoV-2 infection differed between studies. One Canadian study reported that by Sept. 30, 2020, 2.3% of Ontario health care worker infections had occurred in physicians.[2] In terms of mortality among physicians, most studies conducted in 2020 were either case series or relied on data from media reports and obituaries.[31,39–41] However, 1 study in Mexico reported 2.5% mortality in physicians with SARS-CoV-2 infection.[42]

Several factors may explain the low infection rate among physicians in our study, but the most important are likely adequate access to personal protective equipment and a relatively low community prevalence of SARS-CoV-2 in Ontario during the study period.[43–46] For context, SARS-CoV-2 infection rates were 3 times higher in the United States than in Ontario in April 2020, and 15 times higher in December 2020 (of note, testing availability was widespread in Ontario by June 2020).[47,48] The lower infection rate in Ontario may be attributed to public health measures implemented early in the pandemic, including closure of nonessential businesses, limits on social gatherings, travel restrictions and the transition of schools to virtual learning.[10]

The strengths of our study include a population-based design that included all registered physicians in Ontario, thereby avoiding nonresponse bias. We examined tests and results recorded in provincial laboratory databases, which prevents self-report bias. Further, we focused on the prevaccination period, and therefore our results are not confounded by the introduction of effective vaccines. Finally, we were able to capture clinical outcomes in physicians who tested positive for SARS-CoV-2 infection, which adds to the existing literature.

Limitations

The prevalence of SARS-CoV-2 infection was estimated from PCR-based test results; hence, the true prevalence may be underestimated. Physician residential location may not reflect a

physician's actual practice location during the study period. Our analysis of associated outcomes was restricted to the first positive test, and outcomes in physicians with a second SARS-CoV-2 infection would therefore be missed. Our categorization of physician specialties could have resulted in overrepresentation of SARS-CoV-2 infection in some specialties, and underrepresentation in others. Missing data could have led to inaccuracies in our estimates. Finally, with our data sources, it was not possible to determine whether SARS-CoV-2 was transmitted between patients and physicians, and if so, in which direction.

Conclusion

In our population-based cohort study of Ontario physicians during the prevaccination period, we found that nearly half were tested at least once for SARS-CoV-2 infection, 0.9% tested positive and no physicians died. These estimates are markedly lower than those reported in other countries and may reflect comprehensive public health measures implemented in Ontario early in the pandemic. Future research should examine vaccination rates and infection rates among other health care providers as the pandemic evolves.

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