COVID-19 screening of asymptomatic patients admitted through emergency departments in Alberta

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Funding statement / Competing interest: none (details at the end of the manuscript)

Text word count: 2371
Abstract word count: 250

Key words: SARS-CoV-2, COVID-19, asymptomatic, screening

Abstract

Introduction: The prevalence of COVID-19 among asymptomatic patients admitted to hospital has implications for personal protective equipment (PPE) use, testing strategy and confidence in the safety of acute care services.

Methods: During the study period (April-9 to May-24, 2020), only symptomatic Albertans were eligible for COVID-19 testing. We extended rt-PCR COVID-19 testing to anyone with a negative COVID-19 symptom screen who was admitted via emergency department (ED) to three Alberta hospitals. We compared the rates of infection of asymptomatic patients to those admitted via ED in the same study hospitals who were tested for symptoms.

Results: The study period encompassed Alberta's initial epidemic curve, with peak active cases per 100,000 of 71.4 (on April 30, 2020), and 14.7 and 14.6 at the beginning and end respectively. Aggressive measures of containment were followed by a rapid decline of the effective reproductive number, which was consistently below 1 from April 30, 2020. COVID-19 testing was done on 1,814 asymptomatic people admitted via the ED in the three study sites (mean age 55 ±22 years; 51% men) and none tested positive. Of the 1,561 people concurrently admitted and tested for COVID-19 based on symptoms, 71 were positive for SARS-CoV-2 (4.5%, 95% CI 3.6-5.7%).

Interpretation: Protocolized assessment of symptoms during the admission process was effective at identifying patients for COVID-19 infection and prevention control measures and testing. There does not appear to be additive benefit to testing asymptomatic patients upon hospital admission in a setting of widespread community testing and strong public health containment.

Introduction

Compared to other highly pathogenic human coronaviruses (MERS-CoV and SARS-CoV), SARS-CoV-2, the virus responsible for COVID-19, has a lower case-fatality rate but spreads more efficiently.[1] SARS-CoV-2 is considered to be largely transmitted from symptomatic patients through respiratory droplets and direct and indirect contact.[2] Transmission of SARS-CoV-2 is possible from people without classic respiratory symptoms (e.g., asymptomatic, pre-symptomatic, pauci-symptomatic), although this has mostly been documented in close quarters (e.g., within households, cruise ships).[3] If people who are asymptomatic and unknowingly positive for SARS-CoV-2 are admitted to hospital, they can infect healthcare workers or other patients.[3,4] In this paper "asymptomatic" will refer to patients who screen negative on a standardized COVID-19 symptom checklist.

Prevalence of asymptomatic carriers of SARS-CoV-2 has been shown to depend on how widespread COVID-19 is in a population, with estimates ranging from 0.34% in Iceland, for example, where less than 1% of the population was positive for SARS-CoV-2 to 10% in the Diamond Princess cruise ship, where 20% of passengers eventually tested positive.[3] Given the frequency of close human interaction in hospital settings, the risk of SARS-CoV-2 transmission from asymptomatic patients could be higher than in settings of community transmission, if appropriate standard precautions are neglected. According to a recent report during an explosive epidemic in New York, 14% of currently asymptomatic women admitted for delivery had positive SARS-CoV-2 testing, further underscoring the importance of local epidemiology in guiding protective measures.[5] Swab results alone without a four-week symptom history, however, may overestimate the risk of asymptomatic transmission, as reverse-transcriptase polymerase chain reaction (rT-PCR) can remain positive following COVID-19 recovery due the detection of non-viable virus.[6]

Assessing the proportion of patients admitted to hospital who have no symptoms and test positive can provide useful data for policy makers. These data may assist in assessing the pandemic's impact on health systems, assigning appropriate in-hospital precautions, including isolation requirements and room assignments, and minimizing healthcare worker risk by informing personal protective equipment (PPE) strategies. These data can also assist decision-making about possible expansion or restriction of asymptomatic testing for admitted patients and would inform follow-up strategies for contact tracing.

In this study, we determined the prevalence of SARS-CoV-2-infection among all patients without symptoms who were admitted to three tertiary care/regional Hospitals via an Emergency Department (ED), for a six-week period between April 9th and May 24th, 2020.

Methods

Design and setting: As part of the epidemic response, all patients admitted to hospital via ED who had symptoms according to a symptom assessment protocol (Table 1a) were tested for COVID-19. Although the list is limited to core respiratory symptoms (e.g., fever, cough, sore throat, breathing difficulties), we cannot exclude that exposure history and other symptoms (e.g., gastrointestinal symptoms or loss of taste or smell) may have also been considered as new evidence emerged during the study. In this study, we temporarily expanded this testing strategy to all consecutive people who were admitted through three Alberta Health Services (AHS) EDs (one each in the Edmonton, Central, and Calgary AHS Zones) and had no symptom. Between April 9th and May 24th, these people, who would not otherwise have been tested for COVID-19, underwent nasopharyngeal or throat swabbing for COVID-19 prior to transfer to an inpatient unit. As per usual practice, swabs were performed by the admitting service or their delegate. These asymptomatic patients were not routinely put on contact and droplet precautions, unless the risk screening tool indicated an increased risk of COVID-19, i.e. recent travel or contact with a probable or confirmed case (Table 1b). However, AHS policy during this period required the continuous use of medical masks in addition to the usual careful hand hygiene for the care of all patients.

Procedures: Clinical staff conducted an initial evaluation to ensure patients had no symptoms and collected specimens, with a study number on the ordering form to ensure ProvLab (Alberta Precision Laboratory (APL)) was able to separately track samples for all admitted asymptomatic patients. ProvLab performed SARS-CoV-2 rT-PCR on each sample, and provided the following data for analysis: age, sex, location of test order, and test result. If a patient in this study had tested positive, protocols for notification and contact tracing were in place, including an assessment by Infection Prevention and Control (IPC) teams to determine if the patient remained asymptomatic or developed symptoms, and to contact trace within the hospital setting and the community, as appropriate.

Outcome measure: The primary outcome was the proportion of asymptomatic patients who tested positive for COVID-19. We planned to assess the proportion of those who tested positive and developed influenza-like-illness (ILI) symptoms after testing (e.g., pre-symptomatic) as well as the mean number of healthcare workers who were furloughed per patient, and the number of healthcare workers and patient contacts who tested positive in the subsequent two weeks. We compared age and sex of the asymptomatic people included in this study with those concurrently admitted to the same three study hospitals via ED during the study and were tested because they were symptomatic. We also estimated the risk of COVID-19 infection in these symptomatic patients.

Statistical methods: We used frequencies, mean and standard deviation (SD) for sample description. We used the methods proposed by Wilson to estimate the 95% confidence intervals (CI) of proportions,[7] because standard methods for CI estimation that take a multiple of the standard error either side of the estimated quantity are sensitive to extreme values of these quantities. Accordingly, we did sample size estimation using a margin of error approach,[8] assuming an alpha error of 0.05 and a power 80%. We estimated that we needed to test at least 800 participants to estimate a prevalence of 1% with a margin of error of 0.7 (from 0.3% to 2%). We estimated that a sample of 1,500 participants would have reduced this margin of error to 0.5-1.8%. To provide additional context, we summarized the incidence of daily cases in Alberta for the health zones including the study sites (i.e., three zone-specific epidemic curves). We also estimated the effective (time-dependent) reproductive number using Bayesian methodology,[9] to identify the point in time when it remained consistently below 1 (indicating the outbreak was under control). We assumed an uncertain distribution of the serial interval using a truncated normal distribution with parameter estimates from existing studies.[10-13]

Results

Epidemic context

Following the provincial declaration of the State of Public Health Emergency (March 17), approximately half of the hospital admissions at the three study sites occurred via ED access (data not shown). Figure 1 shows the daily new cases of COVID-19 and the number of Albertans who were

tested in these three zones (Calgary, Central and Edmonton). The study period encompassed Alberta's initial epidemic curve, with peak active cases per 100,000 of 71.4 (on April 30, 2020), and 14.7 and 14.6 at the beginning and end of the study respectively. The Calgary Zone accounted for most of the cases. The effective reproductive number remained below 1 after April 30, 2020 (Figure 2).

Cohort description

During the study period (April 9th to May 24th), 3,375 people were hospitalized through the EDs in the three study sites. Of these, 1,814 (54%) people were asymptomatic and formed the cohort for this quality improvement study. Figure 3 shows the distribution of study participants who were admitted daily by site over the study period: 755 in the Edmonton Zone (42%), 614 in the Central Zone (34%) and 445 (24%) in the Calgary Zone. On average, 40 study participants were admitted each day (SD 12; median 39, range 4-73). Results were available within the same day of testing (16%), within one day (75%) or within two days of testing (98%); 2% were available on days 3-7. The mean [SD] age of the study participants was 55 years [22] and 51% were men, with no difference in these characteristics across study sites.

Outcomes

None of the study participants tested positive for SARS-CoV-2, including in subsequent testing after they left the ED. Among those who were admitted via EDs during the study period and had symptoms (N=1,561 mean age [SD] 47 [19] years; 51% men), 71 were positive, 4.5% (95% CI 3.6-5.7%). Of these, 68 were from the Calgary Zone hospital (risk in the Calgary zone 7.5%; 6-9.5%).

Discussion

In this study, we found that none of the 1,814 consecutive people who were admitted to hospital via one of the three EDs in Alberta without symptoms consistent with SARS-CoV-2 infection had a positive rT-PCR swab. Conversely, 4.5% of people with symptoms in the same ED setting were positive on testing, being as high as 7.5% at the hospital within the Calgary Zone. These findings suggest that admission processes, including assessment of symptoms, are effective at identifying patients who should be tested and isolated in the context of hospital admission.

The government of Alberta implemented a rapid response to the COVID-19 outbreak. Within three weeks of detecting the first positive case in the province on March 5, 2020, aggressive public health measures were implemented, including physical distancing and hand and respiratory hygiene recommendations, closure of schools and many non-essential services, and recommendations for working from home where possible. Patients presenting to hospital were screened for core respiratory symptoms, although we cannot exclude that exposure history and other symptoms may have also been considered as new evidence emerged during the pandemic. We conducted our study during a timeframe when localized outbreaks were identified in many long-term care and designated supporting living facilities, and others in workplaces, shelters and the community, including the two largest outbreaks in meat packing plants with over 1500 cases within the Calgary zone. Although during the first three weeks of the study the estimated effective reproductive number was still above 1, the provincial outbreak was being brought under control in Alberta. Consistent with our findings, in a recent report from the United Kingdom about rT-PCR screening of asymptomatic healthcare workers, the probability of positive testing rapidly decreased with the decline of the epidemic curve.[14]

Our study has health policy implications. Asymptomatic transmission (including pre-symptomatic transmission) of SARS-CoV-2 could reduce the effectiveness of control measures (isolation, use of PPE only for symptomatic, and parameters of contact tracing) that are informed by symptoms. Concerns regarding asymptomatic transmission were driven by observations in various populations suggesting that as many as 50% of people with positive rT-PCR in various settings were asymptomatic at testing.[15,16] However, risk and dynamics of asymptomatic transmission vary in different settings (household/family, congregate living/long-term care, acute care). Recent data suggest that the asymptomatic proportion may be closer to 15-20%, and although pre-symptomatic spread has been described, the contribution of truly asymptomatic transmission remains unclear.[17] Therefore, depending on the phase of an outbreak, degree of social interactions and the underlying testing strategy, estimates of asymptomatic people in a population may be highly variable. Epidemiologic studies have found highly variable serial intervals (the time between symptoms developing in the infector and infectee), suggesting a much smaller role of asymptomatic transmission.[10-13] Our data support the current Alberta approach of not using continuous droplet and contact PPE for healthcare workers when caring for low-risk patients in hospital or long-term care settings, a strategy that has been advocated due to concerns of asymptomatic transmission. In addition, testing of asymptomatic

or low-risk people would require unnecessary extension of isolation protocols and may lead to potential harms associated with false positive tests, and waste of scarce health care resources, including testing supplies.

Our study also raises the contentious question of when during an epidemic should testing be conducted on asymptomatic people and whether it should be done at all. Testing asymptomatic people early in an outbreak could provide information about the extent of unrecognised cases and in turn how health policy interventions should be implemented and intensified. Testing conducted later, when health policy interventions have already brought the outbreak under control may convey important information about how restrictions can be lifted. However, the optimal strategies for asymptomatic testing need to be developed to optimize resource use, with considerations for enhanced testing for people at higher risk of infection (e.g., essential workers or older adults), and people at higher risk of spreading infection (e.g., those with many community contacts).

Our study has limitations. First, we did not test patients without defined COVID-19 symptoms during the early phase of the epidemic. Although the number of cases had not yet peaked within the initial period of this study, community transmission in Alberta may have remained below the threshold above which everyone is considered potentially exposed and asymptomatic cases are more common. Second, results from the province of Alberta where aggressive health policy measures were implemented rapidly may not be generalizable to other contexts and settings. For example, the proportion of people admitted via ED who were determined to be symptomatic was high (almost 50% of all admissions), suggesting a relatively low threshold for testing during the study period. Third, we focused on the prevalence of asymptomatic people admitted to hospital through EDs, and the individuals seeking care in EDs during a pandemic may not represent the general population, other types of healthcare or congregate settings, or patients admitted through other routes (obstetrical assessment, direct admission, surgeries, transfers from other facilities, admission from outpatient departments). Context-specific characteristics of the environment and people need to be considered when generalizations are made to other settings and regions. Finally, although the symptom assessment protocol was extremely effective in this study, it would be expected that the use of an expanded COVID-19 symptom screening list may be more sensitive in defining low-risk patients for whom isolation is not required. A comprehensive screening tool has recently been implemented to

include non-respiratory symptoms (chills, loss of smell and taste, gastrointestinal symptoms, and others) and a comprehensive risk exposure assessment.[18]

In summary, in this six-week study of 1,814 consecutive patients admitted to three emergency departments in Alberta who had no defined COVID-19 symptoms, none was positive for SARS-CoV-2. The symptom assessment protocol was highly discriminatory, as no asymptomatic patient tested positive, even in the geographic area experiencing most of COVID-19 cases, where 7.5% of those admitted via the emergency department who were tested based on symptoms were SARS-CoV-2 positive. Careful assessment of symptoms during the admission processes is effective at identifying patients who should be tested and isolated in the context of hospital admission.

Contributions:
Study concept and design, analysis plan: EL; BM; LM
Data collection: KF; SM; BM; PR
Analysis: SM; PR
Manuscript draft: all authors
Manuscript revision: all authors
Contributed to intellectual content: all authors
Study supervision: PR; BM

Transparency: All authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Funding: This study was not supported by any specific funding.

Competing interests: All authors declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethics approval: University of Calgary REB20-0689, issued on May 4, 2020.

Data sharing: We are not able to make our dataset available to other researchers due to our contractual arrangements with the provincial health ministry (Alberta Health), who is the data custodian. Researchers may make requests to obtain a similar dataset at https://sporresources.researchalberta.ca.

Disclaimer: The interpretation and conclusions contained herein are those of the researchers and do not represent the views of the Government of Alberta, Alberta Health, Alberta Health Services, the Cumming School of Medicine or the University of Calgary.

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Figure legend

Figure 1: Daily incidence of testing and positivity rates across Alberta

Figure 2: Effective reproductive number during the COVID-19 outbreak in Alberta

Figure 3: Number of daily admissions of study participants by site

Table 1: Alberta Health Services Covid-19 Screening Tool

Table 1a: Symptom Screening Questions – used to determine the need for testing (outside the context of this pilot) during this study period

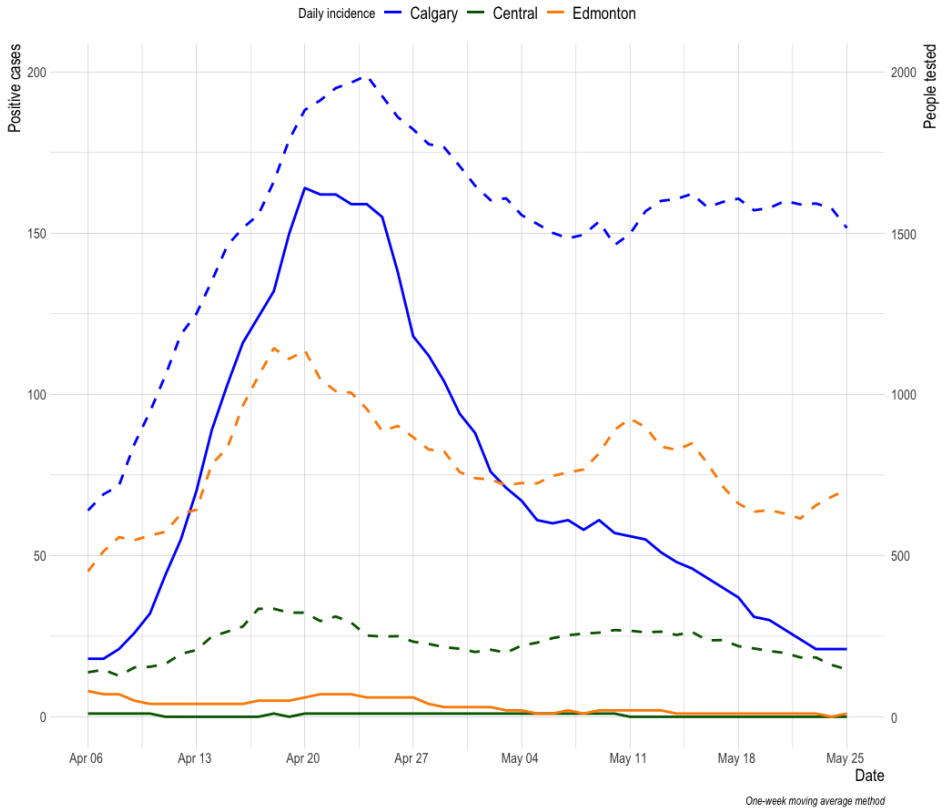
1	Do you have the symptoms below?	Please Circle	
	• Fever (greater than 38 degrees Celsius)	Yes	No
	• Cough	Yes	No
	• Shortness of breath	Yes	No
	• Difficulty breathing	Yes	No
	• Sore throat	Yes	No

Table 1b. Risk Assessment: Screening Questions – used to determine the need for isolation, but not specifically to guide testing

1	Have you returned to Canada from outside the country (including USA) in the past 14 days?	Yes	No
2	Do you live with or have had **close contact*** (within 2 meters/6 feet) with a person with an influenza-like illness (ILI) who has travelled outside of Canada within the last 14 days before their illness?	Yes	No
3	Do you live with or have had **close contact*** (within 2 meters/6 feet) with someone who is ill with fever and/or cough **and** ILI symptoms?	Yes	No
4	Have you had **close contact*** (within 2 meters/6 feet) with a confirmed or probable case of COVID-19?	Yes	No

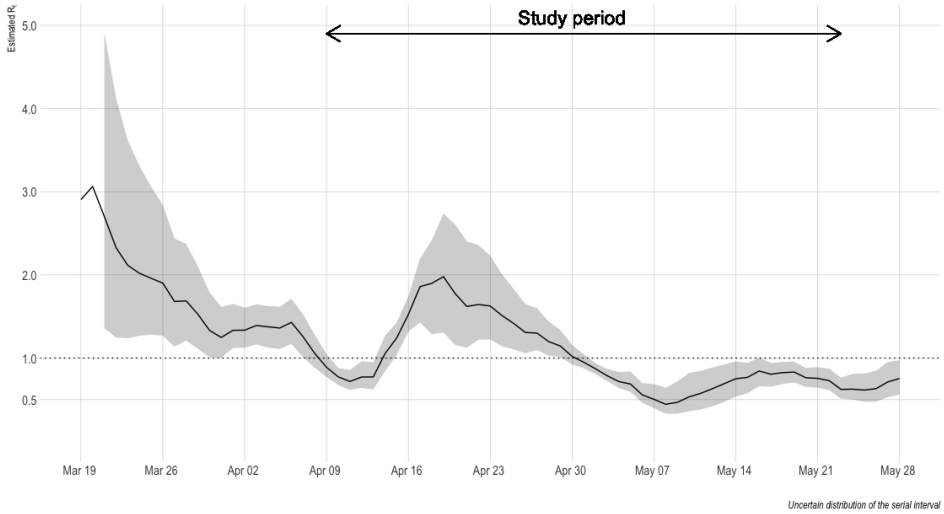
***Close contact** is an individuals that provided care for the case, including healthcare workers, family members or other caregivers, or who had other similar close physical contact without consistent and appropriate use of personal protective equipment (PPE), **OR** lived with or otherwise had close prolonged contact (within two meters/six feet) with a person while the case was ill, **OR** had direct contact with infectious body fluids of a person (e.g. was coughed or sneezed on) while not wearing recommended PPE.

If you answer "NO" to all of the above, the patient is considered low-risk



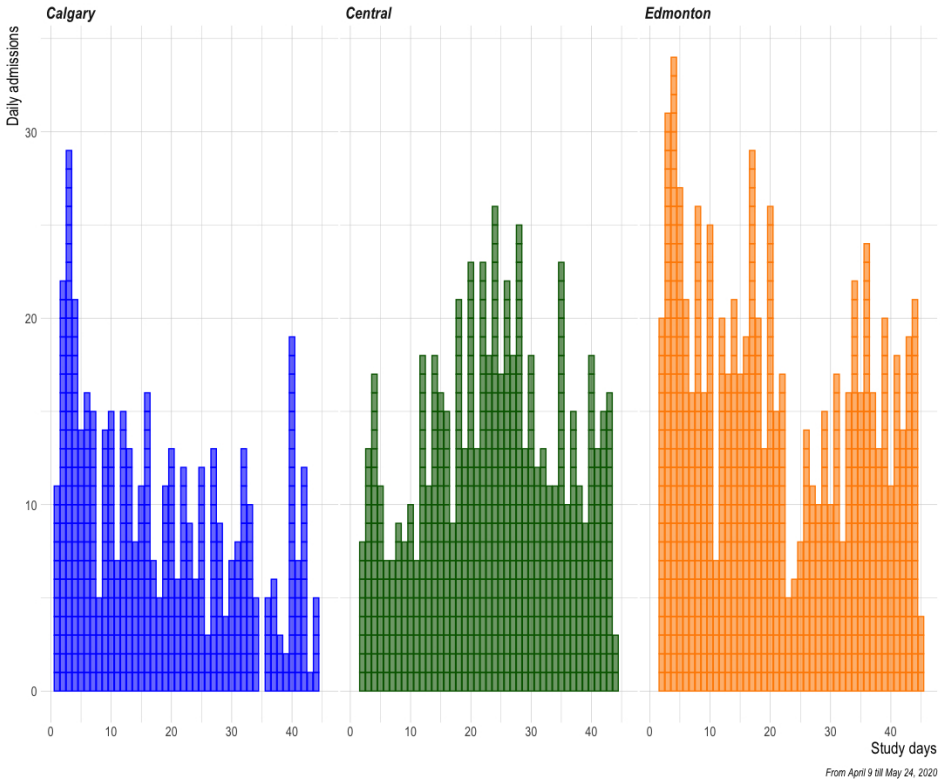
Daily incidence of testing and positivity rates across Alberta / Legend: Daily incidence of testing and positivity rates across Alberta

387x355mm (72 x 72 DPI)



Caption: Effective reproductive number during the COVID-19 outbreak in Alberta / Legend: Effective reproductive number during the COVID-19 outbreak in Alberta

418x252mm (72 x 72 DPI)



Caption: Number of daily admissions of study participants by site / Legend: Distribution of daily hospital admissions via emergency department by hospital during the study period in each study site (Calgary, Peter Lougheed Centre; Central Zone, Red Deer Regional Hospital; and Edmonton, Royal Alexandra Hospital)

404x355mm (72 x 72 DPI)