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Research

Patients in hospital with laboratory-confirmed COVID-19 in a network of Canadian acute care hospitals, Mar. 1 to Aug. 31, 2020: a descriptive analysis

Robyn Mitchell MHSc, Kelly Baekyung Choi MSc, Linda Pelude MSc, Wallis Rudnick PhD, Nisha Thampi MD, Geoffrey Taylor MD; for the CNISP COVID-19 Working Group*

Abstract

Background: Information on the epidemiology of patients in hospital with laboratory-confirmed coronavirus disease 2019 (COVID-19) in Canadian acute care hospitals is needed to inform infection prevention and control strategies and public health measures. The aim of this surveillance was to describe the epidemiology of patients in hospital with laboratory-confirmed COVID-19 in a network of Canadian acute care hospitals between Mar. 1 and Aug. 31, 2020.

Methods: Through prospective surveillance, we identified adult and pediatric patients in hospital with laboratory-confirmed COVID-19 using a standard definition between Mar. 1 and Aug. 31, 2020, through the Canadian Nosocomial Infection Surveillance Program (CNISP), a network of 78 hospitals. Patient demographic and clinical characteristics and data on treatment, interventions and outcomes were reviewed and described.

Results: As of Aug. 31, 2020, the CNISP had received data for 1906 patients in hospital with COVID-19 in 49 sentinel hospitals in 9 provinces. The majority of patients in hospital with COVID-19 were older (median age 71 yr) and had underlying medical conditions (85.8%). Few children with COVID-19 were admitted to a participating hospital (n = 37, 1.9%). Acquisition of COVID-19 in hospitals was infrequent (6.4% of all cases). A total of 32.8% of patients were admitted from a long-term care facility or retirement home. Health care workers constituted 10.6% of adult patients aged 18–65 years in hospital with COVID-19. Thirty-day attributable mortality was 16.2%. Hospital admission rates peaked in mid-April and were highest in Ontario and Quebec.

Interpretation: Surveillance findings indicate that a high proportion of Canadian patients in hospital with COVID-19 during the first 6 months of the pandemic were older adults with underlying medical conditions. Active surveillance of patients in hospital with COVID-19 is critical to enhancing our knowledge of the epidemiology of COVID-19 and to identifying populations at risk for severe outcomes, which will help guide Canada's response in the coming months.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the novel coronavirus that causes coronavirus disease 2019 (COVID-19), has spread across the globe and placed a substantial burden on health care systems. In Canada, the first patient with laboratory-confirmed COVID-19 was admitted to hospital on Jan. 23, 2020,[1,2] and as of Aug. 31, 2020, 138 010 cases of COVID-19 had been reported.[3] Patients in hospital with COVID-19 have been described in the United States,[4–10] China[11,12] and Italy.[13] The aim of this study was to describe the epidemiology of patients in hospital with laboratory-confirmed COVID-19 through surveillance conducted in a national network of Canadian acute care hospitals. It is essential that these data be reported in a timely manner as they are needed to inform infection prevention and control strategies, prioritize health care resources and inform public health measures as we anticipate additional cases in the months ahead.

Methods

Study design and sources of data

The Canadian Nosocomial Infection Surveillance Program (CNISP) is a collaboration between the Public Health Agency of Canada, the Association of Medical Microbiology and Infectious Disease Canada and sentinel hospitals across

Competing interests: None declared.

*A list of the other members of the working group is provided at the end of the article.

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Correspondence to: Robyn Mitchell, robyn.mitchell@canada.ca

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Canada.[14] In 2020, a network of 78 acute care hospitals across 10 provinces and 1 territory participated in the CNISP, including 9 pediatric stand-alone hospitals. Of these, 14 were large acute tertiary care hospitals with more than 500 beds, 38 were hospitals of intermediate size (201–500 beds) and the remaining 26 hospitals were smaller facilities with fewer than 200 beds.

The CNISP conducts surveillance for health care–associated infections, including viral respiratory infections. On Mar. 15, 2020, surveillance was expanded to include all patients in hospital with laboratory-confirmed COVID-19. Forty-eight CNISP hospitals in 9 provinces conducted prospective sentinel surveillance of adult and pediatric patients in hospital with COVID-19.

Study population and case definitions

Between Mar. 1 and Aug. 31, 2020, patients of any age who were admitted to a CNISP hospital within 14 days of a positive SARS-CoV-2 test result were eligible for inclusion. Health care acquisition was defined as symptom onset 7 or more calendar days after admission to the reporting hospital or if the patient was readmitted with a positive test result in fewer than 7 days after discharge from hospital and using best clinical judgment (e.g., if the patient had symptom onset < 7 d but a known epidemiologic link to a positive case). Seven days was chosen as a conservative cut-off to attribute acquisition to the reporting hospital on the basis of an estimated median incubation of 4 days (interquartile range [IQR] 2–7 d) (March 2020).[15] A health care worker was defined as any person who provided direct patient care.

Outcomes and data collection

The following outcomes were collected and identified at 30 days from the date of the positive test result: admission to an intensive care unit (ICU), receipt of mechanical ventilation, all-cause mortality and attributable mortality. Attributable mortality was defined as COVID-19 being the cause of death or contributing to death.

Experienced and trained hospital staff (infection control professionals) reviewed the medical records of eligible patients using a standardized case report form to collect data on patient age; sex; health care worker status; underlying medical conditions; clinical presentation; receipt of antimicrobials, antivirals and other medications; interventions (ICU admission, invasive mechanical ventilation, extracorporeal membrane oxygenation and dialysis); and outcomes (still in hospital, discharged, transferred or died). On the basis of the evolving epidemiology of COVID-19 documented in the literature,[4–7] obesity was added to the standardized case report form in June 2020. Retrospective case identification of patients admitted back to Mar. 1, 2020, was conducted.

Once 30-day outcome data were collected, the data were submitted to the Public Health Agency of Canada through the Canadian Network for Public Health Intelligence, a secure online platform. In addition to the detailed patient data presented in this report, the CNISP has been collecting weekly aggregate data on the number of incident COVID-19 cases in hospital from 148 CNISP and non-CNISP hospitals since Mar. 15, 2020. Data were cleaned and verified by epidemiologists at the Public Health Agency of Canada. Inconsistencies in the data were verified by the submitting hospital.

Statistical analysis

Analyses were conducted using R version 3.5.1 and SAS EG version 7.1. Missing and incomplete data for individual variables were excluded from analyses; therefore, denominators may vary. Fisher–Freeman–Halton exact tests and χ^2 tests were used to compare proportions and the Wilcoxon rank-sum test was used to compare medians. Incidence rates were calculated as the weekly number of patients in hospital with laboratory-confirmed COVID-19 per 1000 patient admissions. Weekly patient admissions were estimated using 2019 annual data.

We derived 95% confidence intervals (CIs) from a quasi-Poisson model with clustered sandwich estimators used to adjust for clustering on hospital. For reporting purposes and to ensure confidentiality, we grouped the provinces into 3 regions: west (British Columbia, Alberta, Saskatchewan and Manitoba), central (Ontario and Quebec) and east (Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador).

Ethics approval

This study was either considered exempt from the requirement for ethics approval as a quality assurance study within the mandate of hospital infection prevention and control programs or approved by the research ethics boards at participating hospitals if required by institution-specific policies.

Results

As of Aug. 31, 2020, detailed data on 1906 patients in hospital with laboratory-confirmed COVID-19 were submitted by 49 CNISP acute care hospitals in 9 provinces (Table 1, Appendix 1,

Table 1: Summary of participating hospitals that provided detailed patient information, Mar. 1–Aug. 31, 2020

Province	No. of reporting hospitals *n* = 49	No. (%) of cases *n* = 1906
British Columbia	4	20 (1.0)
Alberta	7	283 (14.8)
Saskatchewan	4	32 (1.7)
Manitoba	2	13 (0.7)
Ontario	13	439 (23.0)
Quebec	5	1073 (56.3)
Nova Scotia	5	28 (1.5)
Newfoundland and Labrador	7	18 (0.9)
Prince Edward Island	2	0 (0.0)

available at www.cmajopen.ca/content/9/1/E149/suppl/DC1). Nine hospitals submitted data on pediatric patients. The median patient age was 71 years (IQR 55–83), and 52.4% (989/1888) of patients were male (Table 2).

Pediatric patients

Thirty-seven (1.9%) patients were younger than 18 years of age. Nine of the 37 children (24.3%) were younger than 1 year of age and 10 (27.0%) were 1–4 years of age. Fifty per cent (18/36) had an underlying medical condition and 16.2% (6/37) were admitted to an ICU. No deaths were reported among pediatric patients.

Health care workers

Health care workers comprised 4.6% (85/1831) of the adult patients and 10.6% (79/740) of the adult patients of working age (18–65 yr) in hospital with COVID-19; 77.5% (31/40) reported having provided direct care to patients who had COVID-19. Two reported travel outside of Canada in the 14 days before symptom onset. ICU admission status was available for 77 health care workers; of those, 36.4% (28/77) were admitted to the ICU, and 3 deaths were reported. When compared with patients aged 18–65 years who were not health care workers, health care workers were more likely to be female (62.0% v. 42.1%, $p < 0.001$); however, they were not significantly different in terms of their median age (53 v. 53 yr, $p = 0.9$), having an underlying medical condition (68.8% v. 75.3%, $p = 0.2$), being admitted to ICU (36.4% v. 31.8%, $p = 0.4$) or dying (3.9% v. 4.7%, $p = 0.7$).

Sources of infection

Among all patients, 56.2% (1064/1894) acquired their infection in the community; 6.4% (121/1894) acquired their infection in hospital (Table 2). Thirteen hospitals in 4 provinces reported nosocomial transmission of COVID-19 over the reporting period. A total of 32.8% of patients (622/1894) were admitted from a long-term care facility or from a retirement home.

Clinical presentation

The median time from symptom onset to admission was 5 days (IQR 2–9 d). The majority of patients (85.8%, 1610/1876) had at least 1 underlying medical condition, and the presence of medical conditions differed significantly by age ($p < 0.001$) (Table 2). Chronic heart disease including hypertension (50.5%), diabetes (27.8%) and chronic lung disease (19.7%) were the most frequently documented conditions among all patients. Among 130 females aged 15–44 years in hospital with COVID-19, 57 (43.8%) were pregnant.

Among all patients, pneumonia was the most common clinical presentation (64.6%, 1147/1776), with the most commonly reported symptoms being cough (55.3%, 1034/1871), fever (55.2%, 1032/1871) and shortness of breath (51.7%, 967/1871). Diarrhea was reported in 18.4% of patients (344/1871), while 11.4% (213/1871) had nausea or vomiting (Table 2).

Younger patients (aged < 40 yr) were less likely to report symptoms than patients 40 years of age or older (84.8% v. 94.4%, $p < 0.001$). Common reasons for admission among asymptomatic younger patients (aged < 40 yr) included trauma, mental health, and labour or pregnancy-related complications.

Interventions and outcomes

Sixty-five per cent of patients received at least 1 antimicrobial, 8.9% received at least 1 antiviral and 10.4% received steroids (Table 3). During their hospital admission, 23.3% (437/1878) of patients with COVID-19 were admitted to the ICU; 14.6% (274/1883) received mechanical ventilation and 0.7% (13/1881) received extracorporeal membrane oxygenation. The proportion of patients who received mechanical ventilation or ICU admission or both significantly differed by age group (Table 3). The ICU admission rate was 4 times higher among patients with an underlying medical condition than among those without (80.0% v. 20.1%, $p < 0.001$). The median age of patients admitted to the ICU who died was 72 years (IQR 65–80) and 72.3% (68/95) were male.

All-cause 30-day mortality was 19.3% (365/1896) and 30-day attributable mortality was 16.2% (300/1855). In bivariable analyses, patients whose death was attributable to COVID-19 were significantly more likely to be older (median age 83.5 yr v. 66 yr, $p < 0.001$) and have an underlying medical condition (97.3% [287/295] v. 83.3% [1279/1535], $p < 0.001$) than those who did not die because of COVID-19. There was no significant difference with respect to male sex (55.4% [165/298] v. 51.6% [794/1539], $p = 0.2$), being admitted to the ICU (25.7% [76/296] v. 22.5% [345/1536], $p = 0.2$) or receiving mechanical ventilation (17.7% [53/299] v. 13.5% [207/1538], $p = 0.05$) between those who died because of COVID-19 and those who did not. The proportion of deaths among patients admitted from a long-term care facility or retirement home was 33.0% (205/621), significantly higher than for all other patients in hospital with COVID-19 (12.5%, 158/1263, $p < 0.001$).

Interpretation

This study contributes to our understanding of the epidemiology and clinical manifestations of COVID-19 among adults and children in Canadian acute care hospitals. The findings show that a large proportion of Canadians in hospital with COVID-19 in the first 6 months of the pandemic were older and had underlying medical conditions. Few hospital admissions of children with COVID-19 were reported.

These results are consistent with data from the US[4,7,10,16–19] and Europe[20] and with reports of milder COVID-19 illness among pediatric patients.[18,21–23] In addition, we found that younger patients (aged < 40 yr) were more likely to report mild or no symptoms. Similar findings were reported from a serological screening study in Lombardy, Italy.[24] This finding may inform screening and testing policies for patients upon admission to hospital.

Table 2 (part 1 of 2): Demographic and clinical characteristics of patients in hospital with laboratory-confirmed COVID-19, Mar. 1–Aug. 31, 2020

Characteristic	No./total no. (%) of cases;* age group, yr						
	All cases *n* = 1906	< 18 *n* = 37	18–39 *n* = 174	40–59 *n* = 416	60–79 *n* = 638	≥ 80 *n* = 638	*p* value†
Age,‡ median (IQR)	71 (55–83)	4 (1–14)	32 (27–35)	53 (47–56)	71 (65–75)	87 (83–91)	
Sex, male	989/1888 (52.4)	17/37 (46.0)	67/173 (38.7)	252/414 (60.9)	376/630 (59.7)	277/632 (43.8)	< 0.001
Health care worker§	79/740 (10.6)	N/A	14/168 (8.3)	52/403 (12.9)	13/172 (7.5)§§	NA	< 0.001
Underlying medical conditions							
Any condition	1610/1876 (85.8)	18/36 (50.0)	123/168 (73.2)	289/411 (70.3)	567/630 (90.0)	610/628 (97.1)	< 0.001
Chronic heart disease¶	948/1876 (50.5)	2/36 (5.6)	13/168 (7.7)	127/411 (30.9)	360/630 (57.1)	445/628 (70.9)	< 0.001
Diabetes	521/1876 (27.8)	1/36 (2.8)	16/168 (9.5)	89/411 (21.7)	215/630 (34.1)	200/628 (31.8)	< 0.001
Lung disease	370/1876 (19.7)	2/36 (5.6)	15/168 (8.9)	63/411 (15.3)	127/630 (20.2)	163/628 (26.0)	< 0.001
Kidney disease	212/1876 (11.3)	1/36 (2.8)	6/168 (3.6)	31/411 (7.5)	69/630 (11.0)	105/628 (16.7)	< 0.001
Other immunosuppression**	73/1876 (3.9)	1/36 (2.8)	5/168 (3.0)	14/411 (3.4)	31/630 (4.9)	22/628 (3.5)	0.6
Cancer	106/1876 (5.7)	3/36 (8.3)	2/168 (1.2)	13/411 (3.2)	50/630 (7.9)	38/628 (6.1)	0.001
Neurologic disorder††	127/1876 (6.8)	3/36 (8.3)	13/168 (7.7)	28/411 (6.8)	50/630 (7.9)	33/628 (5.3)	0.4
Liver disease	54/1876 (2.9)	0/36 (0.0)	5/168 (3.0)	15/411 (3.6)	25/630 (4.0)	9/628 (1.4)	0.05
Obesity (body mass index ≥ 30)	71/1403 (5.1)	1/36 (3.7)	10/168 (7.6)	23/411 (7.3)	29/630 (6.0)	8/628 (3.7)	0.004
Pregnant	57/130 (43.8)¶¶	NA	NA	NA	NA	NA	NA
Symptoms							
Any symptom	1746/1871 (98.3)	26/37 (70.3)	147/167 (88.0)	389/411 (94.7)	594/624 (95.2)	587/629 (93.3)	< 0.001
Cough	1034/1871 (55.3)	12/37 (32.4)	99/167 (59.3)	278/411 (67.6)	372/624 (59.6)	271/629 (43.1)	< 0.001
Fever	1032/1871 (55.2)	15/37 (40.5)	87/167 (52.1)	268/411 (65.2)	374/624 (59.9)	287/629 (45.6)	< 0.001
Shortness of breath	967/1871 (51.7)	7/37 (18.9)	80/167 (47.9)	247/411 (60.1)	359/624 (57.5)	274/629 (43.6)	< 0.001
Pain	386/1871 (20.7)	4/37 (10.8)	57/167 (34.1)	144/411 (35.0)	114/624 (18.3)	67/629 (10.7)	< 0.001
Hypoxia	361/1871 (19.3)	0/37 (0.0)	16/167 (9.6)	70/411 (17.0)	110/624 (17.6)	156/629 (26.2)	< 0.001
Weakness	350/1871 (18.7)	2/37 (5.4)	17/167 (10.2)	75/411 (18.2)	112/624 (17.9)	144/629 (22.9)	< 0.001
Diarrhea	344/1871 (18.4)	5/37 (13.5)	34/167 (20.4)	101/411 (24.6)	116/624 (18.6)	88/629 (14.0)	< 0.001
Fatigue	301/1871 (16.1)	0/37 (0.0)	25/167 (15.0)	68/411 (16.6)	112/624 (18.0)	96/629 (15.3)	0.006

Table 2 (part 2 of 2): Demographic and clinical characteristics of patients in hospital with laboratory-confirmed COVID-19, Mar. 1–Aug. 31, 2020

Characteristic	No./total no. (%) of cases;* age group, yr						
	All cases *n* = 1906	< 18 *n* = 37	18–39 *n* = 174	40–59 *n* = 416	60–79 *n* = 638	≥ 80 *n* = 638	*p* value†
Symptoms							
Altered mental status‡‡	250/1871 (13.4)	0/37 (0.0)	5/167 (2.3)	21/411 (5.1)	78/624 (12.5)	145/629 (23.1)	< 0.001
Vomiting or nausea	213/1871 (11.4)	5/37 (13.5)	28/167 (16.8)	57/411 (13.9)	81/624 (13.0)	42/629 (6.7)	0.001
Headache	174/1871 (9.3)	2/37 (5.4)	30/167 (18.0)	69/411 (16.8)	57/624 (9.1)	15/629 (2.4)	< 0.001
Sore throat	156/1871 (8.3)	4/37 (10.8)	26/167 (15.6)	41/411 (10.0)	58/624 (9.3)	26/629 (4.1)	< 0.001
Chills	110/1871 (5.9)	0/37 (0.0)	12/167 (7.2)	38/411 (9.3)	46/624 (7.4)	14/629 (2.2)	< 0.001
Loss of smell or taste	84/1871 (4.5)	1/37 (2.7)	18/167 (10.8)	35/411 (8.5)	23/624 (3.7)	7/629 (1.1)	< 0.001
Location where COVID-19 was acquired							
Community	1064/1894 (56.2)	34/37 (91.9)	147/172 (85.5)	347/413 (84.0)	376/632 (59.5)	159/637 (25.0)	< 0.001
Hospital	121/1894 (6.4)	1/37 (2.7)	8/172 (4.7)	11/413 (2.7)	45/632 (7.1)	56/637 (8.8)	
Other health care exposure (e.g., long-term care facility)	622/1894 (32.8)	0/37 (0.0)	2/172 (1.2)	24/413 (5.8)	186/632 (29.4)	408/637 (64.1)	
Unknown	87/1894 (4.6)	2/37 (5.4)	15/172 (8.7)	31/413 (7.5)	25/632 (4.0)	14/637 (2.2)	

Note: COVID-19 = coronavirus disease 2019, IQR = interquartile range, NA = not applicable.
*Unless indicated otherwise.
†χ^2 tests were used to compare proportions.
‡Age is missing for 3 cases.
§Restricted to adult patients aged 18–65 yr.
¶Includes hypertension.
**Includes congenital or acquired immunodeficiency, chemotherapy, use of immunosuppressive drugs and chronic use of high-dose systemic steroids (≥ 2 mg/kg or ≥ 20 mg/d prednisone or equivalent for > 2 wk).
††Includes moderate to profound intellectual disability or developmental delay; epilepsy or cerebral palsy if accompanied by moderate to profound intellectual disability or developmental delay; neuromuscular disorders (e.g., muscular dystrophy), when associated with impaired respiratory function; or other neurologic disorders associated with impaired pulmonary function or difficulty handling lung secretions or both.
‡‡Includes confusion and delirium.
§§Age group restricted to 60–65 yr.
¶¶Restricted to females aged 15–44 yr.

Our surveillance data showed that 4.6% of adult patients in hospital with COVID-19 were health care workers, similar to reports from the US[7,16,25] and China[11] (3.4%–5% and 3.5%, respectively). When we restricted our analysis to working-aged adults (18–65 yr), 10.6% were health care workers. Although many health care workers who were in hospital with COVID-19 had provided care to patients with COVID-19, it was beyond the scope of our surveillance to ascertain whether the health care workers acquired their infection occupationally or in the community. In addition, we found that nosocomial acquisition of COVID-19 was infrequent and was limited to sporadic cases across multiple hospitals. Further plans for collecting additional data are underway to better describe health care workers in hospital with COVID-19.

Of concern is the large proportion (32.8%) of patients who were admitted to hospital from a long-term care facility or retirement home. The severe impact of COVID-19 on this vulnerable population has also been reported by the European Union[26] and in the US.[5,8,27] Furthermore, the mortality rate among patients in hospital was highest among patients aged 80 years and older. These findings highlight the severity of the COVID-19 pandemic among older adults and among those living in facilities in Canada.[28] Timely identification of COVID-19 in the community is important for rapid implementation of control measures to protect these and other vulnerable populations.

The incidence of patients with laboratory-confirmed COVID-19 in 148 Canadian acute care hospitals peaked at 15.0 per 1000 admissions in the week of Apr. 19, with a smaller peak in the week of July 12 (4.0 per 1000 admissions) (Appendix 2, available at www.cmajopen.ca/content/9/1/E149/suppl/DC1). The highest hospital admission rates we

Table 3: Treatment, interventions and outcomes of patients in hospital with laboratory-confirmed COVID-19, Mar. 1–Aug. 31, 2020

Treatment, intervention or outcome	No./total no. (%) of cases; age group, yr*						
	All cases *n* = 1906	< 18 *n* = 37	18–39 *n* = 174	40–59 *n* = 416	60–79 *n* = 638	≥ 80 *n* = 638	*p* value†
Antimicrobials							
Any antimicrobial	1154/1785 (64.6)	5/37 (13.5)	77/157 (49.0)	264/384 (68.8)	412/586 (70.3)	395/618 (63.9)	< 0.001
Ceftriaxone	798/1785 (44.7)	4/37 (10.8)	52/157 (33.1)	182/384 (47.4)	287/586 (49.0)	272/618 (44.0)	< 0.001
Azithromycin	875/1785 (49.1)	1/37 (2.7)	60/157 (38.2)	210/384 (54.7)	325/586 (55.5)	278/618 (45.0)	< 0.001
Piperacillin/tazobactam	318/1785 (17.8)	1/37 (2.7)	15/157 (9.6)	49/384 (12.8)	127/586 (21.7)	125/618 (20.2)	< 0.001
Doxycycline	177/1785 (9.9)	0/37 (0.0)	5/157 (3.2)	23/384 (6.0)	63/586 (10.8)	86/618 (13.9)	< 0.001
Vancomycin	138/1785 (7.7)	1/37 (2.7)	12/157 (7.6)	25/384 (6.5)	65/586 (11.1)	35/618 (5.7)	0.004
Amoxicillin/clavulanate	125/1785 (7.0)	2/37 (5.4)	8/157 (5.1)	27/384 (7.0)	50/586 (8.5)	37/618 (6.0)	0.4
Meropenem	91/1785 (5.1)	0/37 (0)	2/157 (1.3)	26/384 (4.2)	43/586 (7.3)	30/618 (4.9)	0.009
Cefazolin	45/1785 (2.5)	0/37 (0)	5/157 (3.2)	12/384 (3.1)	17 / 586 (2.9)	11/618 (1.8)	0.5
Antivirals‡							
Any antiviral	156/1764 (8.9)	1/36 (2.8)	10/162 (6.2)	44/384 (11.5)	64/574 (11.2)	37/605 (6.1)	< 0.001
Oseltamivir	137/1764 (7.8)	0/36 (0.0)	9/162 (5.6)	33/384 (8.6)	61/574 (10.6)	34/605 (5.6)	0.005
Other treatment							
Hydroxychloroquine	302/1785 (16.9)	0/37	20/157 (12.7)	76/384 (19.8)	122/586 (20.8)	83/618 (13.4)	< 0.001
Corticosteroids	185/1785 (10.4)	0/37	12/157 (7.6)	39/384 (10.2)	70/586 (11.9)	64/618 (10.4)	0.1
ICU admission and interventions							
ICU admission	437/1878 (23.3)	6/37(16.2)	40/172 (23.3)	142/411 (34.5)	203/628 (32.3)	46/627 (7.3)	< 0.001
Invasive mechanical ventilation	274/1883 (14.6)	1/37 (2.7)	21/170 (12.4)	93/413 (22.5)	140/632 (22.2)	19/628 (3.0)	< 0.001
Extracorporeal membrane oxygenation	13/1881 (0.7)	NR	NR	NR	NR	NR	NR
Dialysis as a result of COVID-19	49/1834 (2.7)	0/37 (0.0)	1/165 (0.6)	12/405 (3.0)	31/617 (5.0)	5/609 (0.8)	< 0.001
30-d outcome							< 0.001
Still in hospital	272/1896 (14.3)	2/37 (5.4)	8/173 (4.6)	42/414 (10.1)	112/633 (17.7)	108/636 (17.0)	NA
Discharged	1127/1896 (59.4)	34/37 (91.9)	155/173 (89.6)	335/414 (80.9)	369/633 (58.3)	232/636 (36.5)	NA
Transferred	134/1896 (7.1)	1/37 (2.7)	6/173 (3.5)	20/414 (4.8)	42/633 (6.6)	64/636 (10.1)	NA
Death (all causes)	365/1896 (19.3)	0/37 (0.0)	4/173 (2.3)	17/414 (4.1)	110//633 (17.4)	234/636 (36.8)	NA
Death (attributable mortality§)	300/1855 (16.2)	0/37 (0.0)	3/173 (1.7)	14/412 (3.4)	87/619 (14.1)	196/611 (32.1)	< 0.001

Note: COVID-19 = coronavirus disease 2019, ICU = intensive care unit, NA = not applicable, NR = data not reported because of small numbers.
*Age is missing for 3 cases.
†Fisher–Freeman–Halton exact tests and χ^2 tests were used to compare proportions.
‡The following antivirals were less commonly received: lopinavir–ritonavir (14/1764, 0.8%), ritonavir (13/1764, 0.7%), remdesivir (2/1764, 0.1%) and ribavirin (2/1764, 0.1%).
§Defined as COVID-19 being the cause of death or contributing to death.

observed (Ontario and Quebec) coincided with the areas of highest prevalence of COVID-19 in Canada.[3]

Ongoing monitoring of hospital and ICU admissions will provide key information on COVID-19 disease severity in Canada, which will inform public health decision-making and help to optimize mitigation strategies, including the extent to which nonurgent care should be scaled down in preparation for future waves of the pandemic.

Limitations

Our study has several limitations. This report describes initial findings of the epidemiology of the first wave of COVID-19 in a subset of Canadian acute care hospitals; the findings may change as additional data become available. Although we compared outcomes among different inpatient groups, these analyses were descriptive in nature and we cannot draw any causal inferences from these comparisons. Further analyses examining the risk factors associated with severe outcomes will be conducted. CNISP hospitals are predominantly large teaching hospitals, which may receive more severe cases as referral centres; therefore, our results may not be generalizable to all Canadian acute care facilities. It is important to note that our data include patients with severe COVID-19 infection who required hospital admission and are not fully descriptive of all people identified with COVID-19. Finally, the data collected were limited to the information available in patient charts.

Conclusion

This report describes the epidemiology of patients in hospital with COVID-19 during the first 6 months of the pandemic in Canada, using data from a subset of Canadian acute care hospitals. We described populations at risk for severe outcome (such as residents of long-term care facilities) for whom coordinated and targeted prevention and control measures are required. Continued surveillance of hospital admission rates, patient and clinical characteristics as well as outcomes of patients in hospital with COVID-19 is critical to enhancing our knowledge of the epidemiology of COVID-19 in Canada and guiding our response to future waves of infection.

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Affiliations: Public Health Agency of Canada (Mitchell, Choi, Pelude, Rudnick); Children's Hospital of Eastern Ontario (Thampi), Ottawa, Ont.; University of Alberta Hospital (Taylor [deceased]), Edmonton, Alta.

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Other members of the Canadian Nosocomial Infection Surveillance Program (CNISP) COVID-19 Working Group: James Brooks (Public Health Agency of Canada, Ottawa, Ont.), Kathryn Bush (Alberta Health Services, Calgary, Alta.), Jeannette Comeau (IWK Health Centre, Halifax, NS), John Conly (University of Calgary, Calgary, Alta.), Chelsey Ellis (The Moncton Hospital, Moncton, NB); Jennifer Ellison (Alberta Health Services, Calgary, Alta.), John Embil (Health Sciences Centre Winnipeg, Winnipeg, Man.), Gerald Evans (Kingston Health Sciences Centre, Kingston, Ont.), Charles Frenette (McGill University Health Centre, Montréal, Que.), Gregory J. German (Queen Elizabeth Hospital, Charlottetown, PEI), Lynn Johnston (QEII Health Sciences Centre, Halifax, NS), Jennie Johnstone (Sinai Health, Toronto, Ont.), Kevin Katz (North York General Hospital, Toronto, Ont.), Pamela Kibsey (Royal Jubilee Hospital, Victoria, BC), Bonita Lee (Stollery Children's Hospital, Edmonton, Alta.), Marie-Astrid Lefebvre (Montreal Children's Hospital, McGill University Health Centre, Montréal, Que.), Yves Longtin (SMBD Jewish General Hospital, Montréal, Que.), Allison McGeer (Sinai Health, Toronto, Ont.), Dominik Mertz (McMaster University and Hamilton Health Sciences, Hamilton, Ont.), Jessica Minion (Saskatchewan Health Authority, Regina, Sask.), Caroline Quach (Centre hospitalier universitaire Sainte-Justine, Montréal, Que.), Anada Silva (Public Health Agency of Canada, Ottawa, Ont.), Stephanie Smith (University of Alberta Hospital, Edmonton, Alta.), Jocelyn Srigley (BC Women's and Children's Hospital, Vancouver, BC), Paula Stagg (Western Memorial Hospital, Corner Brook, Nfld.), Vivienne Steele (Public Health Agency of Canada, Ottawa, Ont.), Kathryn Suh (The Ottawa Hospital, Ottawa, Ont.) and Alice Wong (Royal University Hospital, Saskatoon, Sask.).

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