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Impact of the COVID-19 Pandemic on Access to Cancer Surgery: Analysis of Surgical Wait Times in British Columbia, Canada

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Original Research

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Abstract

Objective: As coronavirus disease 2019 (COVID-19) spread, efforts were made to preserve resources for the anticipated surge of COVID-19 patients in British Columbia, Canada. However, the relationship between COVID-19 hospitalizations and access to cancer surgery is unclear. In this project, we analyze the impact of COVID-19 patient volumes on wait time for cancer surgery.

Methods: We conducted a retrospective study using population-based datasets of regional surgical wait times and COVID-19 patient volumes. Weekly median wait times for urgent, nonurgent, cancer, and noncancer surgeries, and maximum volumes of hospitalized patients with COVID-19 were studied. The results were qualitatively analyzed.

Results: A sustained association between weekly median wait time for priority and other cancer surgeries and increase hospital COVID-19 patient volumes was not qualitatively discernable. In response to the first phase of COVID-19 patient volumes, relative to pre-COVID-19 pandemic levels, wait time were shortened for urgent cancer surgery but increased for nonurgent surgeries. During the second phase, for all diagnostic groups, wait times returned to pre-COVID-19 pandemic levels. During the third phase, wait times for all surgeries increased.

Conclusion: Cancer surgery access may have been influenced by other factors, such as policy directives and local resource issues, independent of hospitalized COVID-19 patient volumes. The initial access limitations gradually improved with provincial and institutional resilience, and vaccine rollout.

On March 11, 2020, the Wotld Health Organization (WHO) identified a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, coronavirus disease 2019 [COVID-19]) and declared a global infectious pandemic that led to many global disruptions in the delivery and quality of health care.[1] In Canada, British Columbia (BC) introduced mandates on mask usage and vaccines, safe physical distancing guidelines, and reconfigured the distribution of publicly funded resources. Furthermore, the perceived lack of preparedness and anticipation of a high COVID-19 patient volumes, led public health directives to limit access to operating rooms, diagnostic procedures, elective surgeries, and hospital admission. As in most jurisdictions, the cancellation of nonurgent elective surgeries was enacted to preserve access to intensive care units (ICUs) and ventilators for urgent surgeries and COVID-19 patients.[2–4]

In Canada, approximately 43% of people experience a cancer diagnosis at some point in their lifetime.[5] Once diagnosed, patients are ideally provided with an individualized treatment plan that considers their demographic, psychosocial, and disease characteristics. Often, an important part of that plan involves surgery, and the outcome of their surgery may depend on the time it takes to receive the procedure. For a typical cancer patient, the wait time for surgery is defined as follows:

1. First waiting period: patient referred to a surgeon for cancer treatment. Patient is now waiting to see a surgeon.
2. Second waiting period: patient has had their first consultation with the surgeon. Patient is now waiting to complete any required diagnostic tests.
3. Third waiting period: patient has completed all diagnostic tests. Patient is now waiting to determine whether to proceed with surgery.

Table 1. Diagnosis-based prioritization of surgeries and their recommended wait time target

Priority level	Recommended wait time target
P1	Within 2 weeks
P2	Within 4 weeks
P3	Within 6 weeks
P4	Within 12 weeks
P5	Within 26 weeks

Abbreviations: P (1, 2, 3, 4, 5), Priority level (1, 2, 3, 4, 5).

4. Fourth waiting period: the patient has agreed to surgery and all preoperative paperwork complete. Patient is now waiting for surgery. In this report, this period was the wait time of interest.

In BC, the patients are triaged based on a diagnosis-based prioritization code model developed with input from key surgeon stakeholders.[6] The priority levels and their ideal wait time targets are displayed in Table 1. Urgent surgeries refer to P1 and P2 priority levels, and nonurgent surgeries refer to P3-P5 priority levels.

Cancer surgeries that are performed beyond their recommended wait time target can lead to tumor upstaging, overall reduction of survival, and substantial psychosocial distress.[3,7,8] Thus, surgical stewards in BC, whom include members of the BC Cancer Surgical Oncology team, suggest that cancer surgeries be completed within 28 days of diagnosis for most life-threatening cancers.[9] By this standard, 30% of cancer patients in BC did not receive timely surgery in 2019, even before the COVID-19 pandemic.[10]

The emergence of the COVID-19 pandemic further limited access to diagnostic and imaging tools, ICU, and other health-care resources essential for cancer care. Although efforts to preserve resources and reduce the performance of resource-intensive surgical procedures were deemed necessary in preparation for the anticipated high COVID-19 patient volumes, the actual impact of varying COVID-19 patient volumes on cancer surgery access during the pandemic was unknown. Thus, this project evaluates the impact of COVID-19 patient volumes on cancer surgery access, as defined by wait time from the date surgery was scheduled to when it was received, in BC. We hypothesized that, as COVID-19 patient volumes increases, cancer surgery access decreases. Therefore, the null hypothesis was that changes in COVID-19 patient volumes do not cause or correlate with changes in cancer surgery access.

Methods

Study Design and Period

This study was a population-based retrospective, cohort study using pre-existing, nonlinked, administrative databases from the province of British Columbia. The timeline of this study ranged from March 11, 2019, to December 1, 2022. The end date of the study was determined based on the maximum amount of data that would have been available at the time of data collection.

Data Sources

COVID-19 hospitalization data were obtained from the COVID-19 database of BC Centre for Disease Control (BC CDC) to analyze COVID-19 patient volumes. BC CDC is a program within the Provincial Health Services Authority (PHSA) that monitors, coordinates, and assists in investigating viral outbreaks that affect BC.[10] Their COVID-19 database contains population-level changes in COVID-19 incidence, hospital case counts, severe outcome counts, and age profiles.[11]

Individual-level data about surgical interventions were identified from the surgical patient registry (SPR) to examine surgical wait times. The BC SPR is a province-wide web-based registry that presents clinically relevant, accurate, and complete patient-specific information identified by surgeons, procedures, hospitals or institutions, and health authorities.[12,13]

Eligibility Criteria

Institutions that provided COVID-19 hospitalized care in BC were identified, and only those that performed at least 1 P1 or P2 level cancer surgery during the study timeline were included. Patients 18 years and older in BC whose wait time for surgery started within the study period, and whose therapeutic surgery was scheduled to be performed in 1 of BC's 5 health authorities (HA) were selected. Caesarean sections and diagnostic interventions such as endoscopic procedures were excluded except for arthroscopes, which were included due to their invasiveness.

Data Extraction and Diagnosis Groups

To dissociate the impact of COVID-19 patient volumes on urgent and nonurgent patients, cancer and noncancer patients, and priority cancer and nonpriority cancer patients, data on surgical procedures were divided into 4 surgical groups: P1/P2 priority cancer, P1/P2 other cancer, P1/P2 noncancer, and P3-P5 (Table 2). The "P1/P2 priority cancer surgery" diagnosis group included cancers with relatively high frequency or mortality risk such as cancer of the bladder, breast, colon and rectum, endometrium, esophagus, head and neck, liver, lung, ovary, pancreas, prostate, and stomach. Any P1 or P2 level cancer procedure that was not among the priority cancers, was represented in the "P1/P2 other cancer surgery" group. Any noncancer procedure with a P1 or P2 diagnosis-based prioritization was included in the "P1/P2 noncancer surgery" group. Lastly, nonurgent procedures (P3, P4, and P5 level) were included under the "P3-P5 surgery" group.

Data Analysis

To examine the relationship between COVID-19 patient volumes and cancer surgery access, maximum weekly COVID-19 patient volumes and median weekly wait time for surgery were analyzed on the R application and qualitatively reported using line plots. The data between March 11, 2019, and March 10, 2020, were considered the pre-COVID-19 pandemic period and the data between March 11, 2020, and December 1, 2021, were considered as COVID-19 pandemic period. Maximum weekly COVID-19 patient volumes were used because the burden (if any) placed on care would be most visible when COVID-19 patient volumes is at its highest. The weekly wait time for surgery for each of the 4 diagnoses groups was defined by the wait time from the booking date to date of surgery. The reason for analyzing the wait time from when surgery was scheduled, rather than when decision for surgery was made, was to minimize the risk of bias due to missing data. The wait time was examined as a median for each institution within each BC health authority and combined to represent the weekly median wait time for surgery in BC for each of the 4 diagnosis

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Table 2. Study diagnosis groups

Diagnosis group	Description
P3-P5 surgery	All therapeutic surgeries with a diagnosis-based prioritization level of 3, 4, and 5. For example, hip replacement or hernia repair surgeries.
P1/P2 noncancer surgery	Therapeutic surgeries for treatment of noncancer conditions with a diagnosis-based prioritization level of 1 and 2. For example, this group includes coronary artery bypass grafting.
P1/P2 priority cancer surgery	Therapeutic surgeries for treatment of bladder, breast, colorectal, endometrium, esophageal, head & neck, liver, lung, ovary, stomach, pancreas, and prostate cancer with a diagnosis-based prioritization level of 1 and 2
P1/P2 other cancer surgery	All other therapeutic cancer surgeries with a diagnosis-based prioritization level of 1 and 2. These include low volume (e.g., sarcoma) or low mortality (e.g., thyroid) surgeries.

groups. Median was used to analyze wait times as median is less sensitive to outliers and can better reflect the average patient experience.

Results

Baseline Characteristics

Out of the 145 identified hospitals in British Columbia, there were 55 hospitals and 428,846 patients that met the eligibility requirements of this study. Among the included patients waiting for surgery, 6.4% belonged to the P1/P2 priority cancer, 1.1% to the P1/P2 other cancer, 13.7% to the P1/P2 noncancer, and 78.7% to the P3-P5 diagnosis group (Table 3). There were no surgeries that were cancelled, without a rescheduled date, due to COVID-19.

Data Presentation

The findings on COVID-19 patient volumes showed evidence of peaks in volume during 3 different time periods. Based on these COVID-19 patient volumes and peaks, 3 phases were determined as follows to separate the impact and influences during those time periods:

1. First phase: March to June 2020.
2. Second phase: July to early October 2020.
3. Third phase: Middle October 2020 to December 2021.

Impact of COVID-19 Patient Volume on Cancer Surgery Access

The weekly median wait time for P1/P2 priority cancer and P1/P2 other cancer diagnosis groups are plotted against total COVID-19 patient volumes in BC in Figure 1. During the first phase, COVID-19 patient volumes reached their first peak and simultaneously, wait time to urgent cancer surgery decreased. During the second phase, the COVID-19 patient volume reached a greater peak, but this was not associated with an increase or decrease in wait times to urgent cancer surgery. In the third phase, the highest peak of COVID-19 patient volumes was present, and this was also not overlapping with any clear changes in median weekly wait times for urgent cancer surgery (Figure 1A,B).

Table 3. Number of procedures within each diagnosis group

Diagnosis group	Number of patients N = 428,846 n (%)
P1/P2 priority cancer surgery	27,275 (6.4)
P1/P2 other cancer surgery	4932 (1.1)
P1/P2 noncancer surgery	58,904 (13.7)
P3-P5 surgery	337,735 (78.7)

Impact of COVID-19 Patient Volume on Access to P1/P2 Noncancer Surgery

In BC, the weekly median wait time for P1/P2 noncancer surgery group dropped below pre-COVID-19 pandemic levels in the first phase (Figure 2). During the second and third phases, COVID-19 patient volumes reached new peaks that were higher than the first peak, and the weekly median wait times remained similar to pre-COVID-19 pandemic levels during both phases (Figure 2). The weekly median wait time exceeded pre-COVID-19 pandemic levels near the end of the third phase, between November and December 2021 (Figure 2).

Impact of COVID-19 Patient Volume on Access to P3-P5 Surgery

As shown in Figure 3, during the first phase, the first wave of COVID-19 patient volumes occurs and the weekly median wait time for P3-P5 surgery dropped below pre-COVID-19 pandemic levels. Wait times following this period, during phase 2, nearly doubled, while COVID-19 patient volumes decreased to a near zero patient count. During the third phase, wait time for P3-P5 surgeries remained relatively similar to pre-COVID-19 pandemic levels.

Limitations

This study is limited to a universal health-care system that presides in a first-world country and may not apply to countries with different health system frameworks or access to resources. Furthermore, the findings are limited by a qualitative analysis, from which no statistically significant conclusions can be made. The results are also exclusive to the COVID-19 pandemic; provincial and institutional decisions may change based on the severity or mortality risk of future infectious diseases, which could disparately affect cancer surgery access. Last, this study's reported wait time for surgery did not include wait times to seeing a specialist, completing diagnostic tests, and deciding for surgery; thus, the patient's perceived wait time is longer than the measured wait time.

Discussion

This study's evaluation showed that COVID-19 patient volumes did not impact cancer surgery access, as defined by wait time for cancer surgery, in BC during the first 18 months of the COVID-19 pandemic. Thus, we fail to reject the null hypothesis that changes in COVID-19 patient volumes do not lead to changes in cancer surgery access.

In the first phase of the pandemic, when the first peak of COVID-19 patient volumes occurred, wait time for cancer surgery was shortened, but wait time for nonurgent surgery increased. These observed differences in impact of COVID-19 patient

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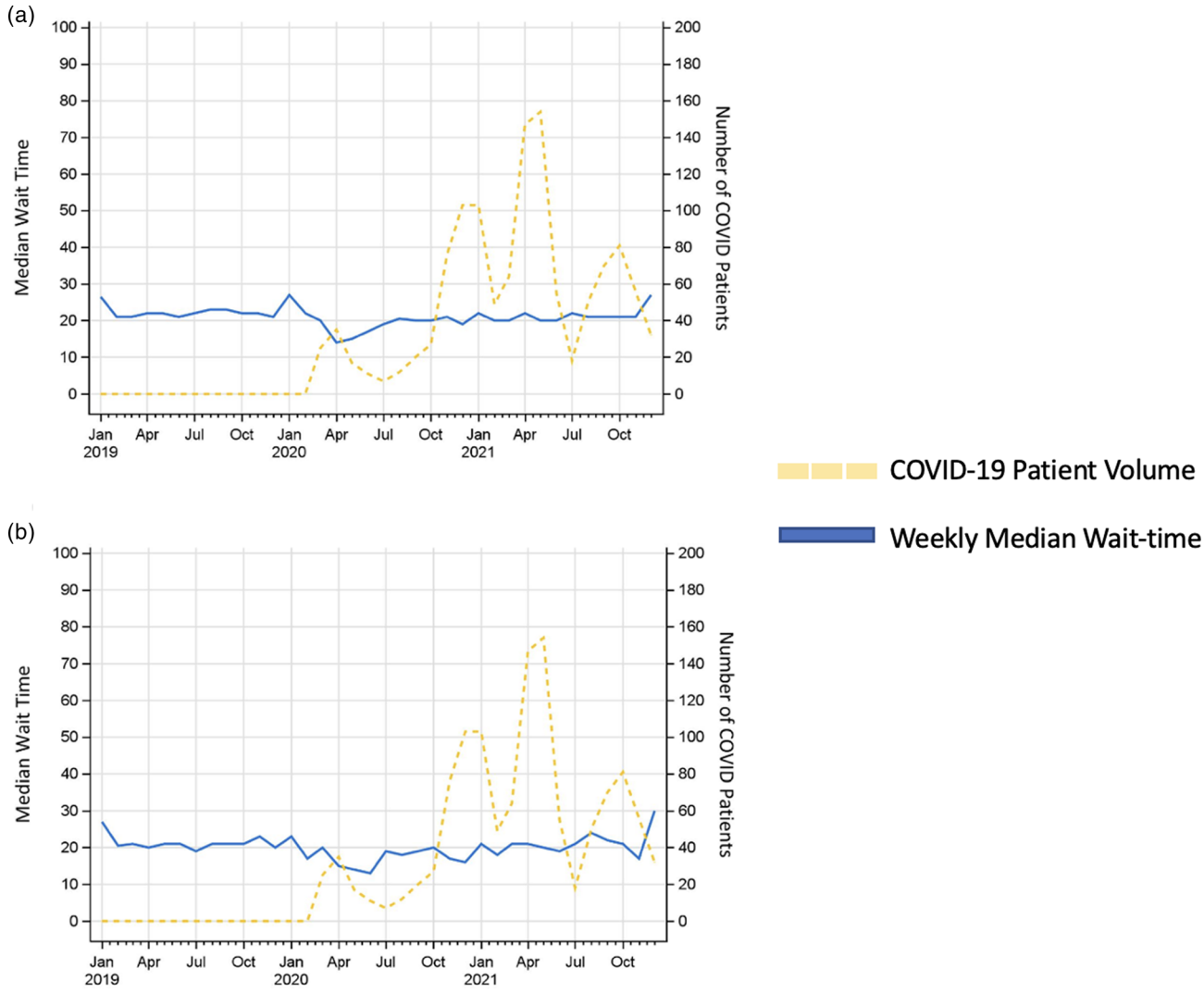

Figure 1. Provincial, weekly maximum COVID-19 patient volume (dotted line) and weekly median wait times (solid line) for P1/P2 priority cancer (A) and P1/P2 other cancer (B) diagnosis groups in British Columbia. COVID-19 patient volume reached its first peak in April-May of 2020, then progressively reached new heights in the winter of 2020, Spring of 2021, and fall of 2021; these peaks did not overlap with any visible change in median weekly wait time for P1/P2 priority cancer surgery (A) or P1/P2 other cancer surgery (B).

volumes on cancer surgery access may be explained by the provincial decision to cancel nonurgent surgeries, which led to the prioritization of urgent surgeries including urgent cancer surgeries. This decision inevitably increased the waitlist, and thus wait time, for nonurgent surgeries and decreased it for urgent cancer surgeries.[14] Additionally, cancer surgery waitlists were likely further reduced as cancer patients felt unsafe to seek care in a hospital setting given the lack of safety protocols during the first phase of the pandemic.[15] This reduction in the patients' perspective can also explain the sharp decrease in wait time to nonurgent surgeries immediately before the first phase. Thus, the decision to cancel nonurgent surgeries explains the subsequent increased wait times for P3-P5 surgeries, and the consequential prioritization of P1/P2 cancer and noncancer surgeries and reduced number of patients waiting explain the observed decrease in wait times for patients in these groups in the first phase of the pandemic.

The second phase of the pandemic, approximately July to early October 2020, can be considered as the period between the first and second COVID-19 patient hospitalization peaks. During this time, COVID-19 patient volumes levels were close to 0, likely due to strict public health measures.[16] Wait time for cancer surgery remained unchanged, and wait time for P3-P5 surgery began to return to pre-COVID-19 levels. The recovery of wait times for nonurgent surgeries can be attributed to the rise of performed surgeries to near prepandemic levels, which occurred as nonurgent elective surgeries were allowed to resume. In this phase, health-care institutions were also given time to implement new safety procedures such as infection control and early discharge; improve clinician awareness, use virtual appointments to minimize exposure, and prepare to manage COVID-19 patient volumes while maintaining access to urgent and nonurgent surgeries.[17–20]

The third phase of the pandemic occurred with the onset of the second COVID-19 patient volumes wave on October 19, 2020.[21] Starting from this date and throughout 2021, COVID-19 patient volumes reached new heights that were nearly quadruple the size of the first wave; however, wait time for surgery remained similar to pre-COVID-19 levels for urgent and nonurgent, cancer, and noncancer diagnosis groups. This further confirms that COVID-19 patient volumes did not impact wait time for cancer and noncancer surgery. This is likely explained by the fact that health-

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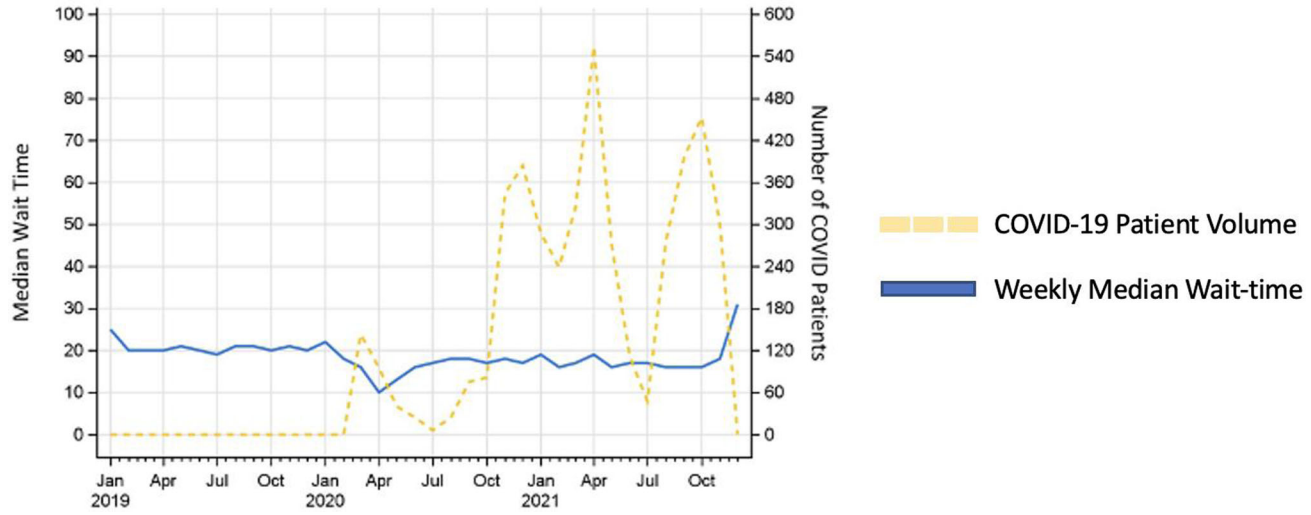

Figure 2. Provincial, weekly median wait time for P1/P2 noncancer surgery (solid line) and weekly maximum COVID-19 patient volume (dotted line) in British Columbia. Following this time, COVID-19 patient volume reached new peaks higher than the first peak between November and December 2020, March and April 2021, and September and October 2021; the weekly median wait time during these peaks were similar to pre-COVID-19 pandemic levels. The weekly median wait time exceeded pre-COVID-19 pandemic levels between November and December 2021 (Figure 2).

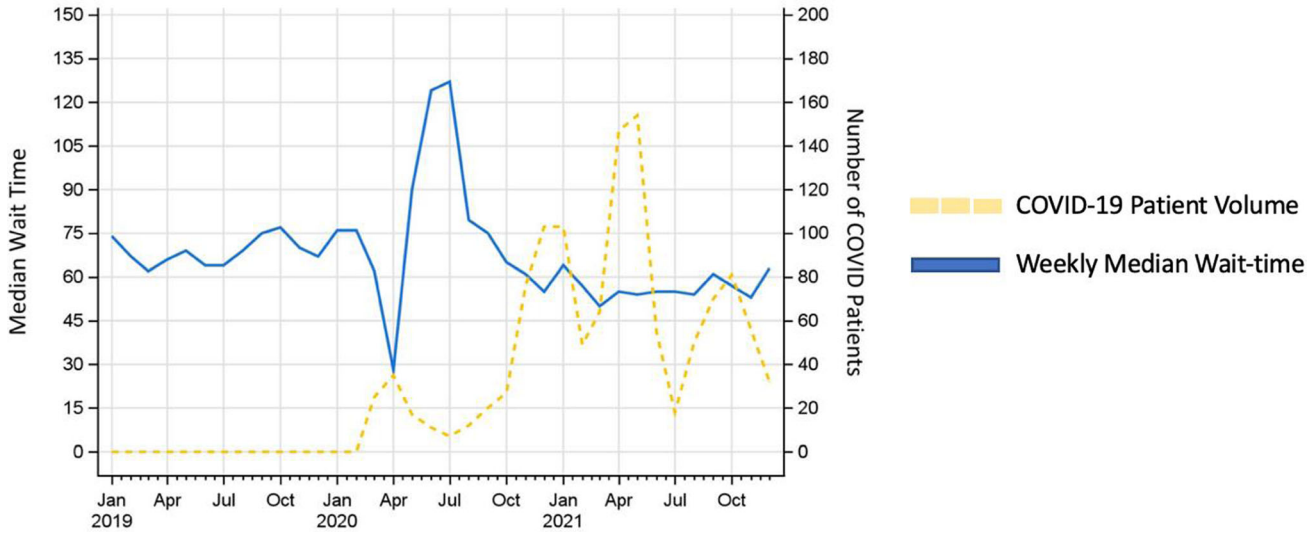

Figure 3. Provincial, weekly median wait time for P3-P5 surgery (solid line) and weekly maximum COVID-19 patient volume (dotted line) in British Columbia. As shown in Figure 3, between April and May of 2020, the first wave of CPV occurs and the weekly median wait time for P3-P5 surgery dropped below pre-COVID-19 pandemic levels. Wait times following this period nearly doubled between June and August of 2020 while CPV decreased to near 0. From October 2020 to December 1 of 2021, wait time for P3-P5 surgeries remained relatively similar to pre-COVID-19 pandemic levels.

care institutions continued to implement initiatives to improve access to care during this time. For example, the BC government's surgical renewal progress report indicated that from November 13, 2020, to February 4 of 2021, there was an increase of 5246 h in operating room (OR) time usage, and 70 new initiatives across all health authorities to optimize OR time and capacity.[22] From April 2020 to November 2021, an additional 44 surgeons, 54 anesthesiologists, over 850 surgical specialty nurses, and 346 medical device reprocessing technicians have been hired in BC.[22] Therefore, it is likely that the preparation of institutions during phase 2 and the continued initiatives during phase 3 allowed for maintenance of access to urgent and nonurgent care, and the increasing COVID-19 patient volumes did not affect this access.

Based on the findings, the suspension of nonurgent surgeries can optimize access to cancer surgery during times of disaster and public health emergencies. This approach may be justified in a scarce resource setting with a lack of sufficient OR and hospital capacity such as in Canada. Specifically, in comparison to a privately funded hospital in a nonuniversal health-care system such as the United States, gynecologic oncology patients in Canada were 1.96 times more likely to experience a delay in cancer surgery during the first wave of COVID-19.[23] Thus, the cancellation of nonurgent surgeries during the first phase of the pandemic may have been imperative to maintaining cancer surgery access and access to COVID-19 care in a health-care system with limited capacity.

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Additionally, the findings from the second and third phases of the pandemic suggest that BC institutions were able to build resilience and recover access to nonurgent surgeries despite high volumes of COVID-19 patients in hospitals. Thus, we call into question whether nonurgent surgical cancellation was a required strategy to maintain cancer surgery access. We propose that through better preparation of health-care institutions, the suspended access to nonurgent surgery could be avoided even in the first phase of a pandemic. If institutions are prepared to immediately implement protocols for early discharge and infectious control, increase use of virtual appointments to minimize exposure, optimize use of OR and hospital resources, and sufficiently recruit health-care workers, they may be prepared to manage the infectious disease without suspending nonurgent surgical access.

Last, we did not find a relationship between COVID-19 patient volumes and cancer surgery access, which makes it difficult to provide a definitive strategy for estimating the volume of COVID-19 patients that would impact cancer surgery access. Instead, we recommend that government and institutional policies and decisions be determined with consideration of access to care for cancer patients. Furthermore, it must be noted that, although the findings are consistent within BC, they may not be generalizable to practice in other provinces or countries with different provincial and institutional mandates and decisions. As well, this study's results are exclusive to the COVID-19 pandemic; provincial and institutional decisions may change based on the severity or mortality risk of future infectious diseases, which could disparately affect cancer surgery access. Last, this study's reported wait time for surgery did not include wait times to seeing a specialist, completing diagnostic tests, and deciding for surgery; thus, the patient's perceived wait time was longer than this study's measured wait time.

This study's findings are also consistent with a study conducted in BC, which found that wait times from diagnosis to breast cancer surgery were shortened between March 16 and April 20, 2020.[24] However, the findings are inconsistent with multiple studies in Italy, which reported a longer wait time for cancer surgery during the first phase of the pandemic.[4,6,25–27] Although Italy engaged in cessation of nonurgent elective surgeries, like Canada, they also experienced a very high initial COVID-19 patient volumes, unlike Canada. The unexpected initial wave of COVID-19 patients likely instigated a sudden health system reorganization without much time for preparation. The virus was initially underestimated in Italy, which led to an emotional efficiency to overcome the outbreak, diverting attention away from cancer patients.[4,6,28]

Conclusions

We are the first study in BC to report the impact of COVID-19 hospitalized patient volumes on access to surgery, and the results are derived directly from the population pool and do not use a sample size. We found that the volume of COVID-19 patients in the hospital did not affect access to surgery for cancer patients. In fact, by cancelling nonurgent surgeries, priority for surgery was given to cancer patients who experienced shorter wait times for surgery at the onset of the pandemic. Wait time for cancer surgery and urgent noncancer surgery decreased at the time of the first wave of hospitalized COVID-19 patients, but they remained unchanged during the greater heights of COVID-19 patient volumes that followed. We also showed that the longer wait time for nonurgent surgeries during the first phase of the pandemic recover back to pre-COVID-19 pandemic levels quickly as health-care institutions build resilience. Thus, we suggest that any changes in access to urgent and nonurgent cancer surgeries may have been more dependent on policy changes and decisions of health-care institutions and provincial regulations, rather than COVID-19 patient volumes.

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Author contributions. Delaram Shojaei: conceptualization of research idea, goals, and aims; development of methodology; verification of the study outputs; writing and collection of data access requests and research ethics application; writing the original draft of manuscript and conducting revisions based on feedback; preparation, creation, and presentation of study through a poster; management and coordination of study planning and execution. Brendan Bakos: formal statistical analyses including application of statistical techniques to synthesize study data; provision of computing resources and analytical tools; data curation including production, maintenance, and storage of research data. Jonathan Loree: feedback on initial research study formulation and protocol; mentorship throughout study conduction; feedback including review and editing of pre-publication stages of the current manuscript. Allison Mah: feedback on initial research study formulation and protocol; feedback including review and editing of pre-publication stages of the current manuscript. Colleen McGahan: conceptualization of study goals and methodology; validation of study validity and outputs; contribution to statistical analyses and data collection; supervision including mentorship and leadership of study execution. Terry Phang: feedback throughout study completion; supervision including mentorship and leadership of study outputs and execution; feedback including review and editing of pre-publication stages of the current manuscript. Carl Brown: conceptualization of research idea; conceptualization of study goals and methodology; verification of the study outputs; feedback on initial research study formulation and protocol; mentorship throughout study conduction; supervision including mentorship and leadership of study outputs and execution; feedback including review and editing of pre-publication stages of the current manuscript.

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Ethical standards. An ethics application was submitted to the Providence Health Care research ethics board. The ethics certificate number is H20-03561 and the Providence Health Care Institutional Certificate of Final Approval by the board was released on August 21, 2021. This project was a minimal risk research with no known risks or harms and used existing data with no time or involvement required from participants.

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