Lisa Jeffery, MD, Alexis Ryley, RN, MPH, Hamish Hwang, MD, FRCSC, FACS

The impact of the COVID-19 pandemic on the severity of emergency bowel surgery

Patients who required emergency abdominal surgery fared worse in multiple dimensions during the COVID-19 pandemic compared with prepandemic.

ABSTRACT

Background: The COVID-19 pandemic was declared on 11 March 2020. This had an unprecedented impact on both primary and specialty care that went beyond patients directly infected with the SARS-CoV-2 virus. Visits to emergency departments declined precipitously during the pandemic due to hospital avoidance, and when patients did present to the emergency department, it was with more advanced diseases. The objective of this quality improvement project was to compare the severity of emergency abdominal surgery before and during the pandemic.

Methods: We conducted a retrospective chart review of all emergency general surgeries performed at Vernon Jubilee Hospital in the fiscal year prepandemic (2019–2020) and in the first 2 years of the pandemic period (2020–2022). Appendectomies, cholecystectomies, and hernia operations that did not involve the bowel were excluded, as were emergencies following elective surgery. Patient demographics and outcomes were recorded, including two previously validated scores that measure surgical disease severity: the HospitAl length of stay, Readmission, and Mortality rates (HARM) score, scored from 0 to 11, and the World Society of Emergency Surgery (WSES) score, scored from 0 to 18. We also tested whether having a family doctor, being admitted to hospital while COVID-19 admissions were higher than five per month, and presenting more than 72 hours after the onset of symptoms affected outcomes and analyzed results for the 3-month periods following "restrictive" and "permissive" elective surgery shutdowns.

Results: There were 85 cases prepandemic and 147 cases during the pandemic: 78 in the first year and 69 in the second year. Age, sex, Charlson Comorbidity Index scores, and whether the patient had a family doctor were similar prepandemic and during the pandemic. During the pandemic, patients were more likely to have a presentation more than 72 hours after the onset of symptoms (61.2% vs 30.6%, $P < .001$), a colon resection (48.3% vs 32.9%, $P = .023$), ischemic bowel (9.5% vs 1.2%, $P = .013$), overall complications (49.0% vs 15.3%, $P < .001$), Clavien–Dindo 3 to 5 complications (15.0% vs 5.9%, $P = .016$), a longer operating time (135 minutes vs 107 minutes, $P = .001$), a higher HARM score (2.4 vs 1.6, $P = .015$), and a higher WSES score (5.8 vs 3.2, $P < .001$) compared with prepandemic. Complications, the HARM score, and the WSES score were not affected by the lack of a family doctor or by more than five COVID patients admitted concurrently to hospital per month, but presentation after 72 hours was associated with higher HARM and WSES scores. There was a trend toward higher overall complications (51.4% vs 44.4%, $P = .59$), Clavien–Dindo 3 to 5 complications (27.0% vs 22.2%, $P = .66$), a higher HARM score (2.6 vs 1.9, $P = .18$), and a significantly higher WSES score (6.9 vs 4.8, $P = .025$) following restrictive versus permissive elective surgery shutdowns.

Conclusions: Patients who required emergency abdominal surgery fared worse in multiple dimensions during the pandemic compared with prepandemic. We could not demonstrate an association between concurrent COVID-19 admissions or lack of a family doctor with worse outcomes; however, there was a strong association between the pandemic period and delayed presentation and an association between delayed presentation and increased disease severity. Moreover, periods in which outpatient surgery and endoscopy were shut down may have contributed to delays in diagnosis and increased disease severity during the pandemic.

Background

The World Health Organization declared the COVID-19 outbreak as a pandemic on 11 March 2020.[1] This led to subsequent unprecedented lockdown restrictions and public health interventions that varied widely, even between health authorities within the same province. The pandemic

Dr Jeffery is a general surgery resident in the Faculty of Medicine at the University of British Columbia. Ms Ryley is a surgical process improvement lead at Vernon Jubilee Hospital. Dr Hwang is a general surgeon at Vernon Jubilee Hospital and a clinical associate professor in the Faculty of Medicine at UBC.

This article has been peer reviewed.

had widespread deleterious effects on health care delivery and resources, not only directly from respiratory illnesses caused by the SARS-CoV-2 virus but also indirectly due to reduced or delayed presentations to the emergency department for other acute diseases.[2] Patients who required emergency general surgery were no exception: delayed presentations resulted in longer hospital stays[3] and increased morbidity during the pandemic compared with the prepandemic period.[4] There was a significant decrease in the number of emergency surgeries performed at several institutions worldwide during the pandemic.[4-7] Emergency general surgery patient outcomes included increased sepsis scores, morbidity, and mortality rates, as well as more advanced acute and malignant disease processes during the pandemic compared with the prepandemic period.[2-4,8,9]

Vernon Jubilee Hospital in the interior of British Columbia is a 196-bed regional hospital that experienced three periods in which elective (nonurgent) surgery and endoscopy were suspended due to the pandemic. During two restrictive periods, 17 March to 19 May 2020 and 1 January to 28 February 2022, all elective surgeries and endoscopies were postponed. During a third period, 20 August to 25 September 2021, inpatient elective surgery was postponed, but day-care elective surgery and endoscopy were permitted to proceed. The BC Colon Screening Program was also suspended from 1 April to 8 June 2020. Preoperative screening and testing were inconsistent across the province; universal asymptomatic COVID-19 testing was not instituted in the Interior Health Authority, where Vernon is located, until 31 March 2021.

Among general surgeons who delivered acute care surgery services at Vernon Jubilee Hospital, there was a sense that patients were presenting with more advanced pathology during the pandemic compared with prepandemic. A postulated etiology for pandemic collateral damage in the acute general surgery patient population was a delay from symptom onset to presentation to the emergency department.[2,4] This may have been a consequence of both patient hesitancy due to fear of COVID-19 infection and public health measures that discouraged patients from leaving their homes.[2,10] The objective of this quality improvement project was to compare the severity of emergency general surgery cases at Vernon Jubilee Hospital during the prepandemic and pandemic periods and examine potential influencing factors.

The pandemic had widespread effects on health care delivery, not only directly from the virus but also indirectly due to reduced or delayed presentations.

Methods

This project was screened for ethics using the ARECCI screening tool;[11] it was deemed to be low risk by the Interior Health Authority with assistance from the Vernon Jubilee Hospital site quality improvement lead (author A.R.); therefore, it did not require formal ethics review.

We conducted a retrospective chart review and compared emergency general surgery performed during the prepandemic period with emergency general surgery performed in the pandemic period. The prepandemic period was defined as 1 April 2019 to 10 March 2020, and the pandemic period was defined as 11 March 2020 to 10 March 2022, to capture all three periods of elective surgery shutdowns. Due to time and resource limitations regarding the number of charts that could be reviewed, we chose to review only 1 rather than 2 years of charts in the prepandemic period, because the additional data likely would not have affected the results. Appendectomies, cholecystectomies, and hernia operations that did not involve the bowel were excluded because this would have doubled the number of charts that had to be reviewed; therefore, this shifted the focus of the study to complex bowel emergencies. Unscheduled surgeries following elective surgery, such as treating anastomotic leak, were also excluded, because we were interested only in cases that presented to the emergency department.

We recorded patient age, sex, and Charlson Comorbidity Index score[12] and whether the patient had a family doctor. We also recorded the dates of admission and discharge, diagnosis on admission and discharge, whether the patient presented more than 72 hours after the onset of symptoms, the date of surgery, operative procedure, operative time, and histological diagnosis where applicable.

We analyzed the following outcomes: ICU admission, complications, mortality, readmission within 30 days, and hospital length of stay. Complications were graded according to the Clavien–Dindo classification.[13] To objectively assess the severity of emergency surgical conditions, we used two previously validated scoring systems: the HospitAl length of stay, Readmission, and Mortality rates (HARM) score, scored from 0 to 11,[14,15] and the World Society of Emergency Surgery (WSES) score, scored from 0 to 18.[16]

The Interior Health Authority provided records of COVID-19 hospital admissions by month during the study period and a summary of periods of shutdowns of elective surgeries and endoscopy and other important dates. We conducted secondary analyses to test whether having a family doctor, being admitted to hospital while COVID-19 admissions were higher than five per month, and presenting more than 72 hours after the onset of symptoms affected outcomes. We also analyzed results for the 3-month periods following "restrictive" and "permissive" elective surgery shutdowns.

Statistics were calculated using an online calculator.[17] Categorical comparisons were conducted using the chi-square test. Continuous variables were compared using the two-tailed *t* test or Mann-Whitney U-test, where appropriate. A *P* value of .05 or less was considered significant.

Results

There were 85 cases in the prepandemic group and 147 in the pandemic group: 78 in the first year and 69 in the second year of the pandemic. There were no significant differences between the prepandemic and pandemic groups in terms of patient sex, age, Charlson Comorbidity Index, or family doctor status **[Table 1]**.

Compared with the prepandemic group, the pandemic group had significantly fewer cases of small bowel obstruction but higher incidences of delayed presentation (more than 72 hours), ischemic bowel, colon resection, overall complications, and severe complications (Clavien–Dindo 3 or higher) **[Table 1]**. Additionally, surgeries in the pandemic group were longer by an average of 28 minutes, and the mean HARM and WSES scores were both higher than in the prepandemic group **[Table 1]**. The pandemic group also had increased oncologic emergency presentation, complicated inflammatory bowel disease, new stoma creation, ICU admissions, mortality, and hospital length of stay compared with the prepandemic group, but the results were not statistically significant **[Table 1]**.

There were no differences in complications, mean HARM score, or mean WSES score based on family doctor status for the entire study period. COVID-19 admissions were recorded by the Interior Health Authority only when five or more patients were admitted in each month. We found no significant differences in outcomes when there were fewer than five versus five or more concurrent admissions for COVID-19 per month.

Patients who experienced a delay of more than 72 hours from the onset of symptoms to presentation to the emergency department showed a trend toward increased complications, although the results were not statistically significant, but had significantly higher HARM and WSES scores than patients who presented within 72 hours **[Table 2]**.

We compared the 3-month periods following restrictive elective surgery shutdowns (n = 37), in which day-care surgery

TABLE 1. Patient demographics and outcomes in the prepandemic period versus the pandemic period.

	Prepandemic	Pandemic	*P* value
n	85	147	
Male sex (%)	48 (56.5)	65 (44.2)	.072
Mean age (95% CI)*	65.6 (62.2,69)	66.7 (64.3,69.1)	.60
Mean Charlson Comorbidity Index	3.2	3.3	.91
Had a family doctor (%)	76 (89.4)	124 (84.4)	.28
More than 72 hours before presentation (%)	26 (30.6)	90 (61.2)	**< .001**
Oncologic emergency (%)	13 (15.3)	34 (23.1)	.89
Complicated IBD† (%)	1 (1.2)	6 (4.1)	.21
Small bowel obstruction (%)	31 (36.5)	29 (19.7)	**.005**
Ischemic bowel (%)	1 (1.2)	14 (9.5)	**.013**
Colon resection (%)	28 (32.9)	71 (48.3%)	**.023**
New stoma (%)	19 (22.4)	42 (28.6)	.30
Overall complications (%)	13 (15.3)	72 (49.0)	**< .001**
Clavien–Dindo complications ≥ 3 (%)	7 (8.2)	33 (22.4)	**.016**
ICU‡ admission (%)	10 (11.8)	24 (16.3)	.34
Mortality (%)	2 (2.4)	11 (7.5)	.10
Mean LOS§ (days; 95% CI)	9.4 (7.4,11.4)	10.8 (8.9,12.7)	.30
Mean operative time (minutes; 95% CI)	107 (98,116)	135 (121,149)	**< .001**
Mean HARM‖ score (0–16)	1.6	2.4	**.015**
Mean WSES¶ score (0–18)	3.2	5.8	**< .001**

* CI = confidence interval.
† IBD = inflammatory bowel disease.
‡ ICU = intensive care unit.
§ LOS = hospital length of stay.
‖ HARM = HospitAl length of stay, Readmission, and Mortality.
¶ WSES = World Society of Emergency Surgery.

TABLE 2. Outcomes based on time of presentation after onset of symptoms.

	72 hours or less	More than 72 hours	*P* value
n	116	116	
Overall complications (%)	48 (41.4)	58 (50.0)	.19
Clavien–Dindo complications ≥ 3 (%)	16 (13.8)	25 (21.6)	.12
Mean HARM* score (0–16)	1.7	2.6	**.0013**
Mean WSES† score (0–18)	3.9	5.8	**< .001**

* HARM = HospitAl length of stay, Readmission, and Mortality.
† WSES = World Society of Emergency Surgery.

and endoscopy were also postponed, with permissive periods (n = 27), in which only inpatient elective surgery was postponed but day-care surgery and endoscopy were allowed. The restrictive periods showed a trend toward higher overall complications (51.4% vs 44.4%, *P* = .59), Clavien–Dindo 3 to 5 complications (27.0% vs 22.2%, *P* = .66), and mean HARM score (2.6 vs 1.9, *P* = .18) and were associated with a significantly higher mean WSES score (6.9 vs 4.8, *P* = .025) compared with permissive periods.

The **Figure** shows a timeline with 3-month average HARM and WSES scores. Notable spikes in the WSES scores occurred during restrictive shutdown periods but not during the permissive shutdown period. The following are key dates on that timeline:

- 11 March 2020 – Pandemic declared.
- 17 March 2020 – All elective surgeries postponed; only urgent and semi-urgent surgeries permitted.
- 1 April 2020 – Provincial Colon Screening Program suspended.
- 19 May 2020 – Elective surgery resumes.
- 8 June 2020 – Colon Screening Program resumes.
- 21 December 2020 – First COVID-19 vaccines deployed in BC.
- 31 March 2021 – Universal asymptomatic pre-op testing implemented in high-prevalence areas in the Interior Health region.
- 20 August 2021 – Elective inpatient surgery suspended due to the White Rock Lake wildfire and the Delta wave. Endoscopy and day-care elective surgery are allowed to proceed.

Restrictive periods showed a trend toward higher complications and were associated with significantly higher severity scores.

- 25 September 2021 – All elective surgery resumes.
- 1 January 2022 – Omicron wave. All elective surgery and endoscopy postponed. Only urgent and semi-urgent surgeries permitted.
- 28 February 2022 – Elective endoscopy resumes.
- 6 March 2022 – Elective surgery resumes.

Conclusions

In general, our study showed that patients who required emergency abdominal surgery faced worse outcomes during the pandemic compared with the prepandemic period. This agreed with other studies that examined emergency general surgery before and during the pandemic.[3,4,6-8] Our study showed twice the rate of delayed presentations during the pandemic compared with the prepandemic period and that this was associated with more severe disease. Hospital avoidance due to COVID-19 lockdowns and a reduction in the number of emergency general surgery operations has been previously described.[6] This phenomenon extended to all visits to the emergency department[5] and caused delays in nongeneral surgical emergencies.[2] We were not able to determine the reason why patients in our study delayed their presentation and can only speculate that it was due to "stay at home" and "shelter in place" pandemic messaging, especially early in the pandemic period, as previously documented.[10] Access to in-person care was also difficult during the pandemic, though we found no differences in outcomes based on whether or not patients had a family doctor. Despite there being no COVID-19 admissions to hospital, there was an increase in complications and disease severity immediately after the pandemic was declared **[Figure]**. This supports the "collateral damage" theory that increased disease severity and worse

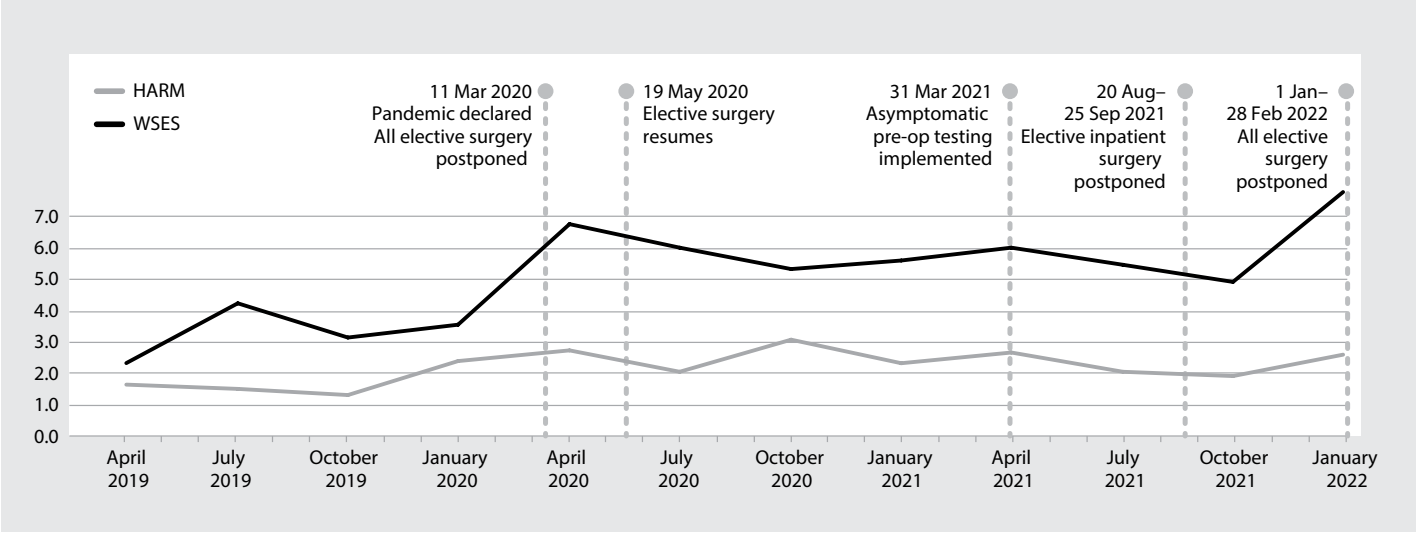

FIGURE. Timeline with 3-month average HospitAl length of stay, Readmission, and Mortality (HARM) and World Society of Emergency Surgery (WSES) scores.

outcomes were not a direct result of the SARS-CoV-2 virus but were due to a combination of public health communications and fear of presenting to hospital, which led to delays in emergency department presentation and poorer outcomes.[2,5,6,8,10]

Although the highest number of COVID-19 hospital admissions occurred in the fall of 2021, which also coincided with a partial evacuation of the hospital in August 2021 due to the White Rock Lake wildfire, which reached the outskirts of Vernon,[18] this was not accompanied by an increase in disease severity as measured by the HARM and WSES scores. It is notable that during this period, elective day-care surgery and endoscopy were permitted to proceed. However, disease severity spiked after all elective surgeries and endoscopies were postponed in March 2020 and then again in January 2022 when the restrictions allowed only urgent and semi-urgent cases **[Figure]**. We found a trend toward increased complications and higher HARM scores and significantly higher WSES scores in the 3-month periods following restrictive periods compared with the permissive periods. During restrictive periods, some diseases, such as colon cancer, inflammatory bowel disease, and ischemic colitis, could not be identified at an early stage during outpatient colonoscopy, and some of these cases may have progressed and eventually culminated in an emergency operation. Also, some conditions, such as hernias, that required elective day-care surgery may have become complicated by incarceration and intestinal strangulation as a result of postponements, which would have prompted emergency surgery.

In terms of colorectal cancer, the COVID-19 pandemic was shown to be associated with fewer operations, a later stage of the disease, more stomas, more urgent and emergent surgeries,[19] more obstructions at presentation,[9] and more complications.[20] Increased colon cancer obstructions were shown to be associated with a decrease in early detection due to suspended screening colonoscopies.[9] Other studies have predicted an increase in colorectal cancer cases and eventual excess deaths from even a short interruption in colon screening.[21] Our study showed a nonsignificant trend toward greater oncologic emergencies and new stomas during the pandemic period and a greater number of colon resections, but not all for cancer. Our study showed an increase in complications and disease severity in general following suspension of the Colon Screening Program from 1 April to 8 June 2020, though it is difficult to isolate the effect of this from other factors, such as hospital avoidance, delayed disease presentation, and inability to access in-person primary and specialty care during COVID-19 lockdowns.

In the early days of the pandemic there were no COVID-19 admissions, yet there was an immediate increase in disease severity at our hospital.

Surgical patients who test positive for SARS-CoV-2 in the perioperative period have a higher risk of complications and mortality.[4] None of the patients in our study had a documented co-infection with COVID-19 during their admission. We found no correlation between burden of COVID-19 hospital admissions and surgical outcomes. In the early days of the pandemic there were no COVID-19 admissions, yet there was an immediate increase in disease severity at our hospital **[Figure]**. There was a decline in overall complications after the introduction of universal pre-op COVID testing in March 2021. The reason for this is uncertain. Other studies have shown a higher complications rate, including ICU admission and mortality, among asymptomatic patients infected with the SARS-CoV-2 virus.[22] We were not able to determine whether this played any role in our study due to the constraints of a retrospective review and the lack of universal testing during the first year of the pandemic, but this would justify future study.

Virtual health care was a sudden adaptation following declaration of the pandemic, which had the advantage of keeping patients from coming into contact with others and becoming infected with SARS-CoV-2.[5] However, the disadvantage was the possibility of misdiagnosis or delayed diagnosis because of the lack of physical examination. We did not find a correlation between the lack of a family doctor and worse outcomes. We were not able to determine whether patients had recently seen their family doctor in person, so the question of whether the lack of in-person care impacted outcomes remains unanswered. However, it is logical to consider that being unable to see one's family doctor may have compounded delayed presentation to the emergency department, because patients with serious conditions would not have been identified and referred urgently at an early stage of illness.

Study limitations

The limitations of this study were the result of its retrospective, single-centre design. The collection of much of the data through the chart review relied on the completeness of dictated reports to accurately capture patients' presentation to and course in hospital. We were unable to include additional data points, such as whether patients had been seen in person by their family physician prior to presentation, because this was not a routine question posed to patients, and it is impossible to determine this retrospectively. Finally, we explored data only from our own centre; however, most shutdowns, restrictions, and precautions were mandated at a provincial level and were similar at other hospitals in BC, so our experience is likely generalizable to other communities.

Summary

Patients who required emergency abdominal surgery fared worse in multiple dimensions during the pandemic compared with prepandemic. We could not demonstrate an association with the number of concurrent COVID-19 admissions or the lack of a family doctor. However, there was a

strong association between the pandemic period and delayed presentation and between delayed presentation and increased disease severity. This reinforces that public health directives need to be balanced with the needs of symptomatic patients who require urgent surgical attention; those patients should be encouraged rather than discouraged from presenting to acute care. Moreover, shutdowns of outpatient surgery and endoscopy may have contributed to delays in diagnosis and increased disease severity during the pandemic period. Future pandemic directives should focus on being as permissive as possible to maximize access to preventive health care while balancing public health requirements. ■

Funding

Funding for this project was provided by the Vernon Jubilee Hospital Physician Society, a branch of the Specialist Services Committee's Facility Engagement Initiative.

Competing interests

None declared.

References

1. World Health Organization. Coronavirus disease (COVID-19) pandemic. Accessed 22 December 2022. www.who.int/europe/emergencies/situations/covid-19.
2. Mogharab V, Ostovar M, Ruszkowski J, et al. Global burden of the COVID-19 associated patient-related delay in emergency healthcare: A panel of systematic review and meta-analyses. Global Health 2022;18:58.
3. Karlafti E, Kotzakioulafi E, Peroglou D-C, et al. Emergency general surgery and COVID-19 pandemic: Are there any changes? A scoping review. Medicina 2022;58:1197.
4. Cano-Valderrama O, Morales X, Ferrigni CJ, et al. Acute care surgery during the COVID-19 pandemic in Spain: Changes in volume, causes and complications. A multicentre retrospective cohort study. Int J Surg 2020;80:157-161.
5. Friedman AB, Barfield D, David G, et al. Delayed emergencies: The composition and magnitude of non-respiratory emergency department visits during the COVID-19 pandemic. J Am Coll Emerg Physicians Open 2021;2:e12349.
6. McGuinness MJ, Hsee L. Impact of the COVID-19 national lockdown on emergency general surgery: Auckland City Hospital's experience. ANZ J Surg 2020;90:2254-2258.
7. Reinke CE, Wang H, Thompson K, et al. Impact of COVID-19 on common non-elective general surgery diagnoses. Surg Endosc 2023;37:692-702.
8. McLean RC, Young J, Musbahi A, et al. A single-centre observational cohort study to evaluate volume and severity of emergency general surgery admissions during the COVID-19 pandemic: Is there a "lockdown" effect? Int J Surg 2020;83:259-266.
9. Mizuno R, Ganeko R, Takeuchi G, et al. The number of obstructive colorectal cancers in Japan has increased during the COVID-19 pandemic: A retrospective single-center cohort study. Ann Med Surg 2020;60:675-679.
10. Wong LE, Hawkins JE, Langness S, et al. Where are all the patients? Addressing Covid-19 fear to encourage sick patients to seek emergency care. NEJM Catalyst 2020.
11. Alberta Innovates. ARECCI ethics screening tool. Accessed 24 December 2022. https://arecci.albertainnovates.ca.
12. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis 1987;40:373-383.
13. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205-213.
14. Keller DS, Chien H-L, Hashemi L, et al. The HARM score: A novel, easy measure to evaluate quality and outcomes in colorectal surgery. Ann Surg 2014;259:1119-1125.
15. Crawshaw BP, Keller DS, Brady JT, et al. The HARM score for gastrointestinal surgery: Application and validation of a novel, reliable and simple tool to measure surgical quality and outcomes. Am J Surg 2017;213:575-578.
16. Sartelli M, Abu-Zidan FM, Catena F, et al. Global validation of the WSES Sepsis Severity Score for patients with complicated intra-abdominal infections: A prospective multicentre study (WISS study). World J Emerg Surg 2015;10:61.
17. Social Science Statistics. Statistics calculators. Accessed 25 December 2022. www.socscistatistics.com/tests.
18. MacPherson M, Dickson C. Paradise lost. CBC News. 15 September 2021. Accessed 14 January 2023. https://newsinteractives.cbc.ca/longform/white-rock-lake-fire.
19. Williams E, Kong JC, Singh P, et al. The impact of the COVID-19 pandemic on colorectal cancer diagnosis and management: A binational colorectal cancer audit study. ANZ J Surg 2021;91:2091-2096.
20. Uyan M, Özdemir A, Kalcan S, et al. Effects of COVID-19 pandemic on colorectal cancer surgery. Sao Paulo Med J 2022;140:244-249.
21. Harber I, Zeidan D, Aslam MN. Colorectal cancer screening: Impact of COVID-19 pandemic and possible consequences. Life 2021;11:1297.
22. Hendrickson NR, Kesler K, DeMik DE, et al. Asymptomatic pre-operative COVID-19 screening for essential and elective surgeries: Early results of universal screening at a Midwestern academic medical center. Iowa Orthop J 2021;41:33-38.

Future pandemic directives should focus on being as permissive as possible to maximize access to preventive health care while balancing public health requirements.