# Melbourne colorectal collaboration: a multicentre review of the impact of COVID-19 on colorectal cancer in Melbourne, Australia

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## Abstract

**Background:** As coronavirus (COVID-19) cases continue to rise, healthcare workers have been working overtime to ensure that all patients receive care in a timely manner. Our study aims to identify the impact and outcomes of COVID-19 on colorectal cancers presentations across the five major colorectal units in Melbourne, Australia.

**Methods:** This is a retrospective study from a prospectively collected database from the binational colorectal cancer audit (BCCA) registry, as well as inpatient records. All patients with colorectal cancer between Pre-COVID-19 period (1 July 2018–2030 June 2019) and COVID-19 period (1 July 2020–2030 June 2021) were compared. Benign pathology and other cancer types were excluded.

**Results:** A total of 1609 patients were included in the study (700 Pre-COVID-19 period, 906 COVID-19 period). During COVID-19 period, there was a higher proportion of emergency surgery (28.1% vs. 19.8%; $P < 0.001$), a higher nodal ($P = 0.024$) and metastatic stage ($P = 0.018$) at presentation, but no increase in the rate of return to operating theatres ($P = 0.240$), inpatient death ($P = 0.019$) or 30-day readmission ($P = 0.000$). There was also no difference in the post-operative surgical complications ($P = 0.118$). Utility of neo-adjuvant therapy did not increase during the pandemic ($P = 0.613$).

**Conclusion:** The heightened measures in the healthcare system ensured CRC patients still received their surgery in a timely fashion. With the current rise in the new strain of COVID-19 (Omicron), we have to continue to come up with new strategies to provide timely access to CRC care.

## Introduction

As coronavirus (COVID-19) cases continue to rise due to the different COVID-19 variants, the care for colorectal cancer (CRC) patients has also dramatically changed. It poses exceptional challenges due to the unparalleled circumstances instigated by the pandemic. Frontline cancer organizations have been working overtime to ensure that these patients receive care in a timely manner in a circumstance where there would be significant delay due to resource reallocation to meet the rising demand from COVID-19 inpatients or staff shortages. Moreover, there

have been recent reports showing that CRC patients have a higher mortality from COVID-19 infection. Therefore, a careful risk versus benefit assessment needs to be conducted for all patients undergoing cancer investigation and treatment during this unprecedented time.[2–5]

Given the uncertainty on the impact of a new virus, a lockdown was instituted in Melbourne, Australia in April of 2020, and since then, metropolitan Melbourne has undergone six lockdowns and has one of the longest periods of lockdown (267 days) to mitigate the resource demands on the Victorian hospital system. This will likely have various repercussions in delivering care to the CRC

patients, with concerns around delay in presentation, referrals, investigations and surgery. Furthermore, during some of the initial lockdowns, the Department of Health and Human Services implemented a state-wide directive to stop all non-urgent surgery including endoscopy in order to preserve hospital resources.[6,7]

The ongoing concerns from the prolonged lockdowns and health government directives are the increasing reports of cancer stage migration and the increased proportion of incurable disease.[8] Furthermore, advanced cancer would often require neoadjuvant therapy, which increases the complexity of surgery and consequently the increased risk of post-operative complications including in-patient mortality.[8]

Most concerning and detrimental to the patient's long-term survival is the increased risk of CRC complication from the delay in seeking appropriate care, such as perforation or large bowel obstruction.[8–10]

In the United Kingdom, the 'Preventing Viral Pandemic Associated Risk of Cancer Death' (PREVAIL)[11] criterion has been adapted to prioritize treatment for patients with CRC, by preventing disparities in diagnosis, surgical intervention and non-surgical treatment options. Some centres have also seen a decrease in outpatients, reduction in endoscopy procedures due to safety concerns regarding aerosol generation, and an increase in short course radiation in rectal cancer.[5,9,12] There were major changes in the delivery of treatment, and the number

**Table 1** Patient characteristics

| | Pre-COVID-19 (n, %) | COVID-19 (n, %) | Total (n, %) | P-value |
|---|---|---|---|---|
| Gender | | | | |
| Male | 410 (58.3%) | 514 (56.7%) | 924 (57.4%) | |
| Female | 290 (41.7%) | 392 (43.3%) | 685 (42.6%) | $P = 0.542$ |
| Age at diagnosis, years old | | | | |
| Mean | $67.4 \pm 14.5$ | $66.7 \pm 13.9$ | | |
| Median | 68 | 68 | | $P = 0.254$ |
| Young adult (<45 years old) | | | | |
| No | 646 (91.9%) | 832 (91.8%) | 1478 (91.9%) | |
| Yes | 57 (8.1%) | 74 (8.2%) | 131 (8.1%) | $P = 1.000$ |
| Presenting symptoms | | | | |
| Pain | 235 (33.4%) | 325 (35.9%) | 560 (34.8%) | $P = 0.316$ |
| Change in bowel habits | 272 (38.7%) | 363 (40.1%) | 635 (39.5%) | $P = 0.607$ |
| PR bleeding | 247 (35.1%) | 305 (33.7%) | 552 (34.3%) | $P = 0.561$ |
| FOBT +ve | 176 (25.3%) | 219 (24.2%) | 395 (24.7%) | $P = 0.640$ |
| Iron deficiency | 211 (30.1%) | 259 (28.6%) | 470 (29.2%) | $P = 0.543$ |
| Bowel obstruction | 89 (12.7%) | 120 (13.3%) | 209 (13.0%) | $P = 0.765$ |
| Bowel perforation | 25 (3.6%) | 25 (2.8%) | 50 (3.1%) | $P = 0.387$ |
| Loss of weight | 136 (19.4%) | 169 (18.7%) | 305 (19%) | $P = 0.749$ |
| Abnormal imaging | 384 (54.9%) | 478 (52.8%) | 862 (53.7%) | $P = 0.420$ |
| Operation setting | | | | |
| Emergency | 127 (19.8%) | 211 (28.1%) | 338 (24.3%) | |
| Elective | 514 (80.2%) | 541 (71.9%) | 1055 (75.7%) | **$P < 0.001$** |
| Afterhours operation | 62 (9.5%) | 91 (10.7%) | 153 (10.2%) | $P = 0.440$ |
| Length of hospital stay (Median days, range) | 8 (0–204) | 8 (0–184) | | $P = 0.675$ |
| Length of ICU stay (Median days, range) | 0 (0–41) | 0 (0–22) | | $P = 0.741$ |
| Hospital setting | | | | |
| Public | 671 (95.6%) | 853 (94.2%) | 1524 (94.8%) | |
| Private | 31 (4.4%) | 53 (5.8%) | 84 (5.2%) | $P = 0.215$ |
| Tumour stage | | | | |
| T stage | | | | |
| • T0 | 24(3.6%) | 39 (4.9%) | 63 (4.3%) | $P = 0.433$ |
| • T1 | 82 (12.2%) | 78 (9.8%) | 160 (10.9%) | |
| • T2 | 106(15.7%) | 123 (15.4%) | 229 (15.6%) | |
| • T3 | 306 (45.4%) | 378 (47.4%) | 684 (46.5%) | |
| • T4 | 156 (23.1%) | 180 (22.6%) | 336 (22.8%) | |
| N stage | | | | |
| • N0 | 406 (63.4%) | 454 (56.3%) | 860 (59.5%) | **$P = 0.024$** |
| • N1 | 149 (23.3%) | 224 (27.8%) | 373 (25.8%) | |
| • N2 | 85 (13.3%) | 128 (15.9%) | 213 (14.7%) | |
| M stage | | | | |
| • M0 | 407 (80.1%) | 410 (74.0%) | 817 (76.9%) | **$P = 0.018$** |
| • M1 | 101 (19.9%) | 144 (26.0%) | 245 (23.1%) | |
| Duration of symptoms prior to presentation (Mean days) | $96.7 \pm 173.0$ | $94.1 \pm 160.3$ | | $P = 0.363$ |
| Days between initial GP referral and colonoscopy (Mean) | $42.7 \pm 62.2$ | $44.2 \pm 70.2$ | | $P = 0.451$ |
| Days between initial GP referral and first seen in Colorectal clinic (Mean) | $51.6 \pm 68.2$ | $52.6 \pm 70.9$ | | $P = 0.558$ |
| Days between initial GP referral and OT (Mean) | $86.3 \pm 83.8$ | $91.5 \pm 92.8$ | | $P = 0.544$ |
| Days between date of diagnosis and OT (Mean) | $54.9 \pm 64.7$ | $54.3 \pm 64.7$ | | $P = 0.953$ |

FOBT, faecal occult blood test; OT, operating theatre.

of operations decreased and surgical methods were adapted to minimize COVID-19 risk. While these changes may have helped protect patients, they are still deviations from pre-pandemic standards of care.

In a recent paper looking at the impact of COVID-19 in Australia and New Zealand, due to the limited periods evaluated, there is still lack of clarity on the true impact of all these prolonged lockdowns on CRC patient outcomes.[6] It is inevitable that this pandemic will have significant effect on the delivery of healthcare to the patient. As such, our study aims to identify the impact and outcomes of COVID-19 on colorectal cancers presentations across the major colorectal units in metropolitan Melbourne, Australia.

## Methods

This study is a collaboration across six major colorectal units in Melbourne, Australia. Hospitals involved include The Northern Hospital, Austin Hospital, Boxhill Hospital, Alfred Hospital, Monash Health and St Vincents Hospital. This is a retrospective study from a prospectively collected database from the Binational Colorectal Cancer Audit (BCCA) registry. Additional data such as non-operative colorectal cancer presentations, emergency cancer presentation, general practitioner (GP) referrals, colorectal clinic dates, colonoscopy dates and treatment modalities were collected from each hospital's multidisciplinary meeting (MDM) records. All patients diagnosed with colorectal cancer were identified and separated into two comparison groups stratified by time of diagnosis; Pre-COVID-19 period 1 July 2018–2030 June 2019 versus COVID-19 period 1 July 2020–2030 June 2021. Exclusion criteria included benign pathology and other cancer types.

After hours operation was defined as procedures performed between 1800 and 0600 h. Long-course chemoradiotherapy involved 6 weeks of concomitant chemotherapy and radiotherapy; short-course radiotherapy involved 1 week of radiotherapy.

### Statistical analysis

Descriptive analysis for continuous data includes mean and standard deviation using the Mann–Whitney $U$ test whereas all categorical data was analysed using Pearson's Chi-square or Fisher's exact test. All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp. and RStudio Team (2015) version 0.99.486, Integrated Development for R. RStudio, Inc., Boston, MA. A $P$-value of <0.05 was considered significant.

### Ethics

Human research ethics approval was obtained at all five hospitals, respectively.

## Results

There were a total of 1609 patients in our study, 700 in the Pre-COVID-19 period, 906 in the COVID-19 period. Nine hundred and twenty-four were males, 685 were females. The average age of diagnosis was similar between the two groups, 67.4 and 66.7 years old during Pre-COVID-19 and COVID-19, respectively. Other patient demographics such as presenting symptoms, length of hospital stay and duration of referrals prior to being seen are listed in Table 1.

During the pandemic, there was a significantly higher proportion of patients requiring emergency surgery, 28.1% compared with 19.8% ($P < 0.001$). This is in the setting that there is no significant difference in the reported colorectal complications (perforation or obstruction) or time difference between days from initial referral to investigation or surgery as shown in Table 1. There was no significant difference in the age of diagnosis ($P = 0.254$), days between initial referral and colonoscopy ($P = 0.451$), days between initial referral and being seen in colorectal clinic ($P = 0.558$) and days between diagnosis and the operation ($P = 0.953$) before COVID-19 or during COVID-19.

Comparing pre- and during COVID-19, there was a significant N ($P = 0.024$) and M ($P = 0.018$) stage shift, signifying more advanced cancer presentations, but no difference in rectal cancer presentations, 28.9% and 29.5% ($P = 0.426$).

There was also no difference in the utility of neoadjuvant ($P = 0.180$) or adjuvant therapy (chemotherapy $P = 0.716$; radiotherapy 0.881). Pre-COVID-19, there was 19.5% post-operative surgical complications, compared to 16.3% during COVID-19 ($P = 0.118$). There was no increase in return to OT ($P = 0.240$). There was significantly lower inpatient death ($P = 0.019$) and 30-day readmission during COVID-19 ($P = 0.000$) (Table 2).

## Discussion

COVID-19 introduced a global challenge for the management of CRC. During the surge, restrictive measures were adopted to reduce exposure and transmission, and to preserve human and material resources. Delays in CRC care were associated with differences in health care delivery systems, hospital preparedness, resource availability and local COVID-19 prevalence. Important influencing factors included hospitals dedicating their services to COVID-19 care, quarantine and/or redeployment of staff, and the availability of personal protective equipement.[13] Essential diagnostic services were also operating at substantially reduced capacity. Changes in health seeking behaviour also meant that routine referrals from GPs have reduced in volume because patients are only presenting when they have major concerns. A study on elective oncological surgery in Italy during COVID-19 emergency phase demonstrated that 70% of surgical divisions had a reduction of hospital beds with an associated 76% reduction of surgical activity owing to the relocation of resources.[14]

Early surgical management of cancer often provides the best chance at curative treatment, as delay may result in progression to locally advanced stages, unresectable disease or metastasis.[1] Due to this pandemic, delays to both diagnostic and therapeutic CRC practices were evident worldwide. This was most likely due to hospital preparedness and availability of resources rather than to geographical factors.[13] Moderate level evidence also suggests that delayed resection of colorectal cancer worsens survival and it has been proposed that primary surgery for early-stage colorectal cancer

**Table 2** Treatment characteristics

| | Pre-COVID-19 (n, %) | COVID-19 (n, %) | Total (n, %) | P-value |
|---|---|---|---|---|
| Cancer type | | | | |
| Colon | 499 (71.1%) | 639 (70.5%) | 1138 (70.8%) | |
| Rectal | 203 (28.9%) | 267 (29.5%) | 470 (29.2%) | P = 0.426 |
| Operative approach | | | | |
| Open | 116 (18.6%) | 123 (17.5%) | 239 (18%) | |
| Laparoscopic | 438 (70.1%) | 512 (73%) | 950 (71.6%) | |
| Conversion of laparoscopic to open | 23 (3.7%) | 22 (3.1%) | 45 (3.4%) | |
| Hybrid | 28 (4.5%) | 20 (2.9%) | 48 (3.6%) | |
| Transanal | 8 (1.3%) | 13 (1.9%) | 21 (1.6%) | |
| taTME | 10 (1.6%) | 7 (1.0%) | 17 (1.3%) | |
| Robotic | 1 (0.2%) | 0 (0%) | 1 (0.1%) | |
| Endoscopic | 1 (0.2%) | 4 (0.6%) | 5 (0.4%) | P = 0.377 |
| Procedures | | | | |
| Hartmanns | 18 (2.9%) | 39 (5.4%) | 57 (4.2%) | |
| HAR | 123 (19.7%) | 141 (19.6%) | 264 (19.7%) | |
| LAR | 56 (9.0%) | 37 (5.4%) | 93 (6.9%) | |
| ULAR | 79 (12.6%) | 73 (10.2%) | 152 (11.3%) | |
| Right hemicolectomy | 213 (34.1%) | 248 (34.5%) | 461 (34.3%) | |
| Extended right hemicolectomy | 24 (3.8%) | 37 (5.2%) | 61 (4.5%) | |
| Subtotal colectomy | 27 (4.3%) | 36 (5.0%) | 63 (4.7%) | |
| Sigmoid colectomy | 2 (0.3%) | 4 (0.6%) | 6 (0.4%) | |
| Transverse colectomy | 1 (0.2%) | 3 (0.4%) | 4 (0.3%) | |
| Left hemicolectomy | 18 (2.9%) | 23 (3.2%) | 41 (3.1%) | |
| Total colectomy | 11 (1.8%) | 11 (1.5%) | 22 (1.6%) | |
| Proctocolectomy | 3 (0.5%) | 8 (1.1%) | 11 (0.8%) | |
| APR | 24 (3.8%) | 18 (2.5%) | 42 (3.1%) | |
| TAMIS | 7 (1.1%) | 13 (1.8%) | 20 (1.5%) | |
| Defunctioning loop ileostomy | 4 (0.6%) | 5 (0.7%) | 9 (0.7%) | |
| Defunctioning colostomy | 2 (0.3%) | 2 (0.3%) | 4 (0.3%) | |
| Stent | 1 (0.2%) | 4 (0.6%) | 5 (0.4%) | |
| Others | 12 (1.9%) | 16 (2.2%) | 28 (2.1%) | P = 0.144 |
| Stoma formed | | | | |
| No | 466 (71.1%) | 593 (74.6%) | 1059 (73%) | |
| Yes | 189 (28.9%) | 202 (25.4%) | 391 (27%) | P = 0.154 |
| Type of Stoma formed | | | | |
| End colostomy | 43 (22.9%) | 57 (28.5%) | 100 (25.8%) | |
| Defunctioning loop colostomy | 5 (2.7%) | 3 (1.5%) | 8 (2.1%) | |
| End ileostomy | 18 (9.6%) | 24 (12%) | 42 (10.8%) | |
| Defunctioning loop ileostomy | 122 (64.9%) | 115 (57.5%) | 237 (61.1%) | |
| Ileoconduit | 0 (0.0%) | 1 (0.5%) | 1 (0.3%) | P = 0.385 |
| Curability | | | | |
| Curative | 605 (86.7%) | 728 (85.2%) | 1333 (85.9%) | |
| Palliative | 93 (13.3%) | 126 (14.8%) | 219 (14.1%) | P = 0.464 |
| Cancer types | | | | |
| Rectal cancer | 203 (28.9%) | 267 (29.5%) | 470 (29.2%) | P = 0.825 |
| Neoadjuvant therapy | | | | |
| No | 605 (86.3%) | 746 (83.8%) | 1351 (84.9%) | |
| Yes | 96 (13.7%) | 144 (16.2%) | 240 (15.1%) | P = 0.180 |
| Neoadjuvant therapy type | | | | |
| Chemotherapy | 7 (7.5%) | 7 (5.7%) | 14 (6.5%) | |
| Long course chemoradiotherapy | 84 (90.3%) | 111 (90.2%) | 195 (90.3%) | |
| Radiotherapy | 0 (0.0%) | 2 (1.6%) | 2 (0.9%) | |
| Short course radiotherapy | 2 (2.2%) | 3 (2.4%) | 5 (2.3%) | P = 0.613 |
| Adjuvant therapy type | | | | |
| Chemotherapy | 274 (39.1%) | 335 (38.1%) | 609 (38.5%) | P = 0.716 |
| Radiotherapy | 21 (3.0%) | 25 (2.8%) | 46 (2.9%) | P = 0.881 |
| Post-operative surgical complications | | | | |
| No | 507 (80.5%) | 608 (83.7%) | 1115 (82.2%) | |
| Yes | 123 (19.5%) | 118 (16.3%) | 241 (17.8%) | P = 0.118 |
| Return to OT | | | | |
| No | 588 (93.5%) | 690 (95.0%) | 1278 (94.3%) | |
| Yes | 41 (6.5%) | 36 (5.0%) | 77 (5.7%) | P = 0.240 |
| Inpatient death | | | | |
| No | 657 (97.3%) | 869 (99.2%) | 1526 (98.4%) | |
| Yes | 18 (2.7%) | 5 (0.8%) | 25 (1.6%) | **P = 0.019** |
| 30-Day readmission | 64 (10.0%) | 26 (3.5%) | 90 (6.5%) | **P < 0.001** |

APR, abdominoperineal resection; HAR, high anterior resection; LAR, low anterior resection; ULAR, ultralow anterior resection; TAMIS, transanal minimally invasive surgery.

should not be postponed for more than 6 weeks due to risk of cancer progression or related complications.[15–18]

In our collaborative study from five institutions, comparing Pre-COVID-19 and COVID-19 period, there was no delay from initial GP referral to being seen in Colorectal clinic and there was no significant delay from diagnosis to the patient receiving their operation. This could be due to the early introduction of telehealth clinics which allowed timely clinic reviews, despite restrictions in face-to-face consultations. We note that these patients had a more advanced nodal and metastatic stage at presentation but there was no increase in the utility of neoadjuvant therapy during this period, suggesting that patients were still able to proceed straight to surgery, due to other more favourable cancer characteristics. More advanced stage presentations could reflect a delay in initial patient presentation to their GP as a result of the lockdown. In addition, there were significantly more emergency surgeries during COVID-19, but this did not result in a higher rate of stoma formation, or a longer length of hospital or intensive care unit (ICU) stay. Instead, the rate of inpatient death or 30-day readmission were significantly lower. Post-operative complications and mortality were not significantly different during Pre-COVID and COVID periods.

At the peak of COVID-19 in Melbourne, the prolonged lockdown had kept the rate of infections low, unlike in other countries. The hospitals have heightened measures to ensure more resources were allocated to emergency surgeries and presentations, to ensure a higher staff to patient ratio in the wards for more critically unwell patients. This may have contributed to the reduction in inpatient mortality and readmission rates in our CRC patients. CRC patients were still considered Category 1 in operative triaging, hence were still prioritized for elective operations. We also adopted the 'public in private' model, where public patients were transferred to the private hospitals for their operation and post-operative care. This enabled us to have increased resources and ensured that our cancer patients received their surgery in a timely manner.

This study highlighted that despite reductions in hospital resources, colorectal cancer patients in Victoria (Australia) were still able to be seen, diagnosed and operated on in a timely fashion. This could be attributed to the rapid uptake of telehealth medicine, whereby GP and hospital outpatient clinics were able to utilize this platform so that patients are still able to receive their consultation in a timely manner. Collaboration between private and public hospitals allowed shared utilization of operating resources; strict triaging of operative cases allowed cancer operations to take priority especially with the scarcity of operating lists; reallocation of hospital resources and staffing allowed for more emergency care which contributed to reduction of inpatient mortality and readmission rates.

At present, the less virulent strain of COVID-19 (Omicron) is spreading rampantly across our community. Multiple healthcare workers have been infected and furloughed. Although this is deemed to be a less virulent strain producing less severe symptoms, this still puts a strain on the healthcare workforce as remaining healthcare workers are working prolonged hours and covering multiple roles. In the community, the rise in infection rates also means an increase in hospitalization rates, which may potentially overwhelm our intensive care or high dependency units. We have to navigate the next few months carefully by continuing to come up with new strategies to provide ongoing timely access to CRC care. We propose that cancer pathways be established and maintained as much as possible at a near normal level, with attention to the backlog of patients, in order to reduce the impact of the COVID-19 pandemic. As the impact of subsequent surges is unknown, as is the long-term effect of the delays on diagnosis and treatment, we hope that our findings will provide important insights regarding the impact of COVID-19 pandemic in CRC care, and can help to mitigate policy interventions to reduce delays in diagnosis.

## Limitations

There are several limitations to this review. First this is a retrospective study and data are reliant on previous documentations. Second, we have only presented on immediate surgical outcomes, and the long-term oncological outcomes are yet to be determined, as we wait for the BCCA registry data to mature. Thirdly, we are still currently in a new wave of Omicron infection, and the behaviour and true impact of this new variant of the coronavirus is unknown.

## Acknowledgements

## Conflict of interest

None declared.

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## Appendix

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