BCCA

BINATIONAL COLORECTAL CANCER AUDIT

2020

DATA AUDIT REPORT

This publication was produced on behalf of the Binational Colorectal Cancer Audit (BCCA).

Data period

The data contained in this report was extracted from the Binational Colorectal Cancer Audit on 31st January 2021 and reports patient episodes and data from January 1st to December 31st 2020 unless otherwise stated.

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Binational Colorectal Cancer Audit (BCCA) is principally funded by:

The Colorectal Surgical Society of Australia and New Zealand (CSSANZ) is the professional body that represents Australian and New Zealand Colorectal Surgeons. CSSANZ members voluntarily fund the majority of costs associated with BCCA to advance the quality of colorectal cancer care in Australia and New Zealand.

Partners:

Monash University through both the Cancer Research Program and Clinical Outcomes data Reporting and Research Program provide database hosting and a secure research environment as well as Academic and Clinical Research guidance, Advocacy and Registry Science expertise. Monash is a leader in multiple Cancer Outcomes Registries and a critical partner in ongoing development of the BCCA.

Supporters:

Medtronic is a global leader in medical technology, services and solutions. Medtronic provides financial support to the BCCA through an annual medical grants program.

The Royal Australasian College of Surgeons (RACS) is an independent professional body committed to enabling surgeons to achieve and maintain the highest standards of surgical practice and patient care. RACS contributes annually to fund ongoing operation of the BCCA.

Epworth HealthCare is Victoria's largest not-for-profit private hospital group. Epworth HealthCare provided funding for BCCA data entry by supporting Clinical Colorectal Fellows and through additional Epworth Research Institute Grants.

Let's Beat Bowel Cancer is a not-for-profit initiative of Cabrini with a vision to significantly lower deaths related to bowel cancer through public awareness, research and medical advances. Let's Beat Bowel Cancer have collaborated with BCCA to aid database development through co-implementation of Patient Reported Outcome Measures (PROMs) software.

Aginic are an agile data analytics company engaged to develop the prototype Clinical Dashboards with BCCA in 2020. Aginic are currently hosting prototypes on behalf of BCCA for free.

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The Steering and Operations committees are to be congratulated on the ongoing evolution of the database. It is through their unwavering commitment and enthusiasm that this tool continues to be refined.

Rowan Collinson

FOREWORD

From the President of the Colorectal Surgical Society of Australia and New Zealand

The BCCA continues to grow as an essential tool to allow surgeons to benchmark their performance amongst their peers. The Steering and Operations committees are to be congratulated on the ongoing evolution of the database. It is through their unwavering commitment and enthusiasm that this tool continues to be refined. I would like to recognise the work of the Operations Committee which has continued to progress the database in many ways, and is committed to seeing the database become sustainable and future-ready. Also to be thanked is Dr Andrew Hunter who continues as Chair of the Steering Committee, and performs an invaluable oversight role.

As evidenced by this publication, the database provides important metrics that are not only referenced by the contributors, but will increasingly be an important foundation of approved research projects within our subspecialty. The audit allows us to demonstrate to the public of Australia and New Zealand that the quality of surgery and cancer care is at the highest levels. It can inform relevant health departments of our commitment to ensure the highest standards of patient care.

Important changes are taking place in presentation and management of colorectal cancer, such as a trend towards younger presentations, and the establishment of population-based screening programs in Australia and now New Zealand. These observations underpin the importance of this disease and consequently the importance of quality local data. Greater linkage to screening and mortality databases in the future could potentially unlock some important trends in these areas, amongst others.

The BCCA has been on this path since 2007, underpinned by funding provided principally by contributing surgeons and their representative surgical societies, including the CSSANZ and RACS Section of Coloproctology.

Again, I congratulate the hard work and commitment of the staff of the BCCA, it's governing boards and contributing surgeons.

Rowan Collinson
President, CSSANZ

From the Chair of the Steering Committee

The Steering Committee is responsible for overseeing the day to day running of the BCCA by the Operations Committee. The Steering Committee provides valuable advice and support to the Operations Committee and is well represented by experienced clinicians from a number of different interest groups with expertise and involvement in the management of colorectal cancer.

The Steering Committee conducted a combined Workshop with members of the Operations Committee in May 2020 as a Zoom meeting & had a further zoom Steering Committee meeting in December.

The Steering Committee is made up of eight members, which include the Chair (Andrew Hunter), who is a member of CSSANZ and nominated by the Colorectal Surgical Society of Australia and New Zealand Council. In addition, there are representatives from CSSANZ Council (President Rowan Collinson), RACS section of colon and rectal surgery (Ian Faragher), General Surgeons Australia Council (Andrew Hughes), New Zealand Association of General Surgeons (previously Grant Coulter but awaiting replacement), as well as another clinician with an interest in colorectal cancer (John Zalcberg) and a consumer representative (John Stubbs) as well as the Chair of the BCCA Operations Committee (Philip Smart) and the project manager (Hayat Dagher).

At each meeting the Chairman of the Operations Committee gives a summary report of the activities of the BCCA Operations Committee over the last six months. Topics discussed included the Annual Report, Movember, funding & budget, data participation, and staffing issues. Updates are also provided for the growing number of research projects. The Master Services Agreement was discussed and ratified by the Steering Committee. A Strategic Plan was submitted to the Committee and this was approved. A proposed link with the National Bowel Cancer Screening Program (NBCSP) is being developed.

The Steering Committee is pleased with the ongoing progress & development & increasing maturity of the Audit and congratulates the members of the Operations Committee for their hard work.

Andrew Hunter
Chair, Steering Committee

From the President of the General Surgeons Australia

The BCCA is a well-established surgical registry applicable to all surgeons who see patients with a diagnosis of colorectal cancer.

The BCCA has aimed to make the audit accessible and relevant to surgeons, both general and sub-specialist, wherever they practice in Australia and New Zealand. The importance of high quality audit data is unquestionable, and GSA has been active in developing and refining the audit. We encourage all our members treating colorectal cancer and carrying out bowel resections to contribute their cases to this important registry.

The interface through which cases are entered is easy to use and forms a convenient database of colorectal cancers treated by the surgeon. Participation also satisfies a RACS Continuing Medical Education (CME) requirement for practice audit.

Trevor Collinson
President, General Surgeons Australia

From the President of the New Zealand Association of General Surgeons

NZAGS continues to support BCCA and the large amount of data that has been collected across New Zealand and Australia over the years. The fact that any general surgeon, even those not specialising in colorectal surgery can contribute to the BCCA, makes the audit tool invaluable. This continuing audit helps surgeons benchmark their management, allowing comparison of outcomes both for individual surgeons and units, which in turn provides avenues for improved care.

The New Zealand Association of General Surgeons encourage all of our members carrying out bowel resections to contribute their cases to this important binational audit. Members may be further encouraged to contribute as participation satisfies a RACS CME requirement for practice audit.

Rowan French
President, NZAGS

From Monash University Partners

Over the past few years, it's been a great pleasure to see the BCCA grow from strength to strength. It does so because of the enormous commitment of so many dedicated colorectal and general surgeons, their trainees and other key staff whose commitment to the goals of the registry – to measure quality of care for this common and potentially life-threatening malignancy, in order to understand where there might be opportunities for improvement, is key to this success.

The growth of the BCCA is occurring at a critical time point in our understanding of the natural history of colorectal cancer in the Australian and New Zealand communities. For some years now, we have been aware that the true incidence of colorectal cancer in people under the age of 50 years is increasing. Whilst the explanation for this change in epidemiology is likely to be multifactorial, the BCCA database helped inform two manuscripts published in 2020[1,2] that demonstrate the inferior outcomes associated with a diagnosis of bowel cancer in younger people. In the context of the US National Preventive Services Task Force recommendations that screening tests for bowel cancer in the US should commence from age 45 years, the data derived from the BCCA will help inform the ongoing re-evaluation of the cost-effectiveness of screening for early bowel cancer in patients aged 45-50 years of age in Australia.

The use of the data held by the BCCA in this manner, is not only one measure of the utility of the BCCA, but for the age group 50-75 years of age, it highlights the enormous potential benefits of linking an outcome database to a screening register (the Government funded, NBCSP) as a means of driving improvements in morbidity and mortality from this disease.

As the BCCA seeks formal government funding to support the BCCA and the associated data collection effort, it's timely to thank the Colorectal Surgical Society of Australia and New Zealand, Royal Australasian College of Surgeons and Medtronic for their ongoing support of this important initiative as well as the members of the Steering Committee, Operations Committee and the Research Committee of the BCCA for their ongoing commitment to this important work. Finally but not least, a huge thanks to Dr Hayat Dagher BCCA Program Manager and the staff in the Registry Sciences Unit in the School of Public Health at Monash for their high quality data analysis and reporting.

John Zalcberg OAM
Head Cancer Research Program, Monash University

As of 31st December 2020 there were 43,002 patients registered representing an additional 4,192 patients since December 2019.

EXECUTIVE SUMMARY

Audit Background

Bowel cancer is the sixth commonest cause of death for Australians[3] and the second most common cause of cancer death[3, 4]. It is also the fourth highest cause of years of potential life lost, accounting for more than 35,000 years of life lost annually[3].

Bowel cancer is both preventable (through polyp detection and removal) and treatable, with established screening programs.

There are many challenges: raising screening rates, defining optimal care pathways, homogenising care across wide geographical regions and addressing many clinical research questions.

BCCA is the major bowel cancer clinical outcomes registry in Australia and New Zealand and aims to describe and compare the quality of care and outcomes of patients diagnosed with bowel cancer.

BCCA captures 28% of incidence cases, with a budget of $150k AUD funded by clinicians and limited sponsorship. We need to do better, to realise the potential of a Clinical Outcomes Registry in defining and improving care, saving lives and preventing morbidity.

The 2021 report is the ninth report to date and includes data on patients diagnosed with bowel cancer between 1st January 2020 and 31st December 2020. The main audience of the Annual Report is clinicians who deliver care to bowel cancer patients, government bodies setting health policy direction, research groups, as well as patients themselves.

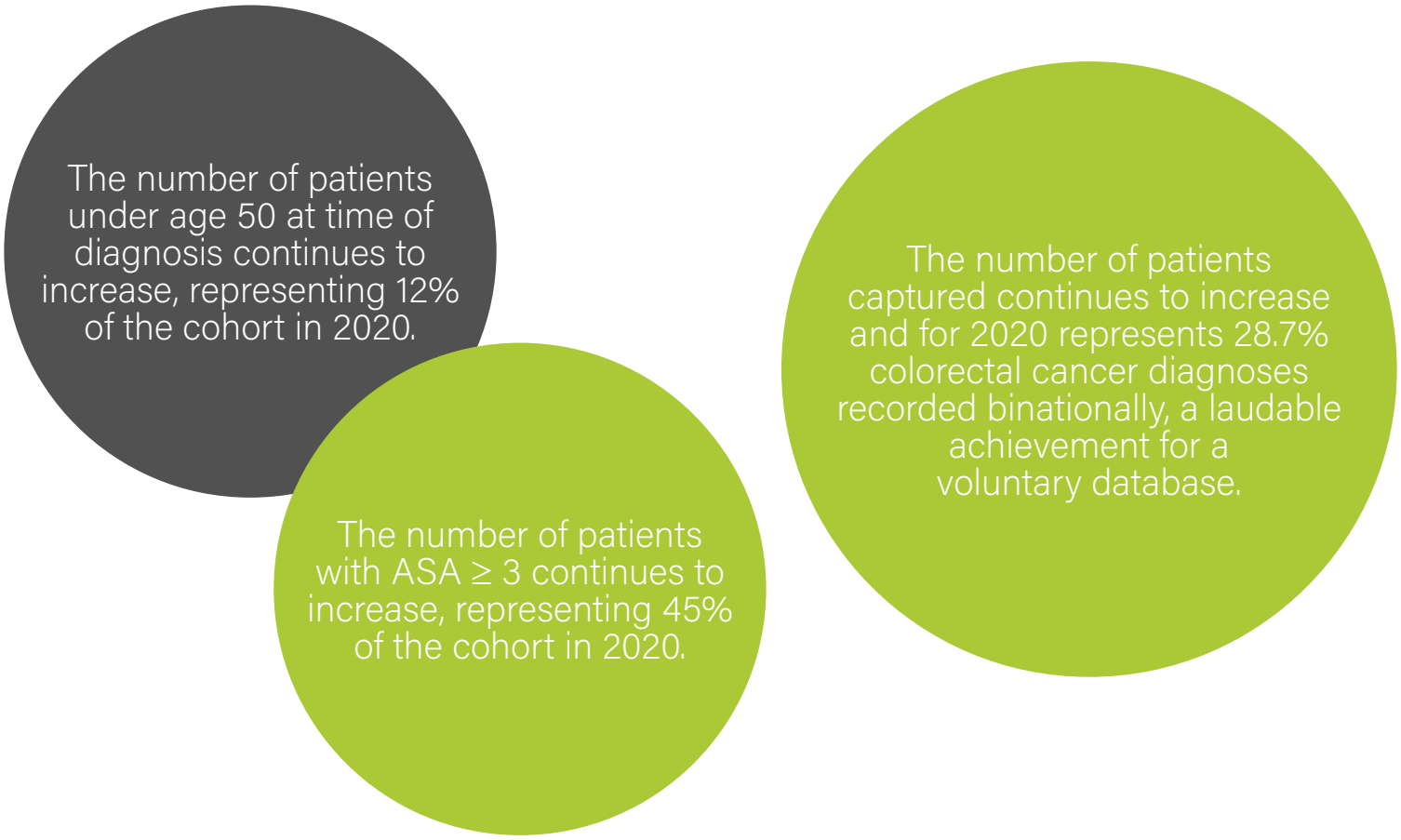
Key Findings

Participation

- As of 31st December 2020 there were 43,002 patients registered representing an additional 4,192 patients since December 2019.
- The number of patients captured continues to increase and for 2020 represents 28.7% colorectal cancer diagnoses recorded binationally, a laudable achievement for a voluntary database.
- The majority of cases reported are from public hospitals (82%).

Demographics

- 54% of cases reported were male.
- The number of patients under age 50 at time of diagnosis continues to increase, representing 12% of the cohort in 2020.
- 45% of the cohort were classified as American Society of Anaesthesiologists (ASA) Classification 3 or greater. This is an increase from 43% last year and reflects an ongoing trend within the audit. In 2012 this was 32%. These patients therefore present higher surgical risk.
- Stage distribution is similar to previous years, with stages II and III being present in the majority of patients at surgery. The number of patients with Stage IV disease increased slightly from 9% to 11%.
- The majority of cases were elective (83%), with emergency cases and urgent cases 9% and 7% respectively.



Screening

- Patients diagnosed following positive faecal occult blood test (FOBT) remained relatively stable in 2020 BCCA cohort.
- FOBT screened patients presented at an earlier tumour stage.

Colorectal Cancer Management

- A minimally invasive surgical approach was utilised in 76% of colon cancers. There has been an increase in robotic colonic resections over the last 3 years.
- There has been a further decrease in the proportion of rectal cancers removed via open resection with a corresponding increase in either laparoscopic or hybrid cases.
- Growth in transanal total mesorectal excision (taTME) has tempered in 2020.
- Preoperative management of rectal cancers continues to evolve. 80% of rectal cancer cases have a magnetic resonance imaging (MRI), and 87% are discussed in a multidisciplinary team meeting (MDT).
- More than half the patients with rectal cancer received neoadjuvant therapy, the majority receiving long course chemoradiotherapy.
- Utilisation of adjuvant therapy is high across stage III colon cancer patients of all ages, only reducing in patients aged over 80 years. The uptake is lower in stage II disease as would be expected; however, it is higher in patients under 50 years, reducing proportionately with increasing age.
- The proportion of patients undergoing surgery for colon cancer experiencing one or more surgical complications was 20%. Fourteen percent of patients had one or more medical complication post-surgery.
- In rectal cancer the surgical complication rate was 28%.
- The anastomotic leak rate was 3% and would generally be considered consistent with good practice, albeit with caveats regarding reporting bias.

Clinical Quality Indicators

- For this 2020 data Annual Report, key performance indicators (KPIs) comprise the most recent 3 years of data only (2018-2020). Comparisons noted in this report are between 2017-2019 data and 2018-2020 data, unless otherwise stated.
- Inpatient mortality remains low at 1%. Inpatient mortality is lower in higher case volume hospitals.
- Return to theatre within 30 days is a broad indicator of significant complications related to surgery. The rate was 5.9% across the audit when risk adjusted.
- Length of stay (LOS) was 7.9 days. The mean LOS of patients undergoing colonic surgery was 7.6 days and rectal surgery 9.4 days. Factors that influence LOS include age, ASA, cancer type, operative urgency, age, overall stage and gender.
- The mean number of nodes retrieved per colonic resection was 20 for the period 2018-2020, up from 18.6.
- The permanent colostomy rate was 21.3%, similar to previously reported and consistent with international data.
- The rate of circumferential resection margin (CRM) involvement remains unchanged at 6.7%.
- The number of patients with an involved CRM who received neoadjuvant therapy was higher in the 2020 audit period (8%) when compared to those who did not (4%), suggesting that preoperative staging was selecting high risk patients for neoadjuvant therapy.

The Binational Colorectal Cancer Audit (BCCA) is a clinical outcomes registry for clinicians involved in the care of patients with bowel cancer. It is led by those committed to excellence in the prevention, diagnosis and treatment of patients with colorectal cancer. The BCCA aims to create a large integrated dataset to be used for quality improvement and research.

INTRODUCTION

The Binational Colorectal Cancer Audit (BCCA) is a clinical outcomes registry for clinicians involved in the care of patients with bowel cancer. It is led by those committed to excellence in the prevention, diagnosis and treatment of patients with colorectal cancer. The BCCA aims to create a large integrated dataset to be used for quality improvement and research.

Governance

The BCCA is overseen by the BCCA Steering Committee in coordination with the BCCA Operations Committee.

Employment and financial management remain under the auspices of the CSSANZ Council. The Steering Committee is composed of senior clinicians and a consumer representative and is responsible for oversight of BCCA activities including that of the Operations Committee, providing ongoing review of objectives and effectiveness. The Operations Committee is responsible for the day to day management of BCCA, developing quality measures and forming relevant subcommittees to address data access, research and quality issues. The BCCA Research Committee was established in 2020 with the aim of guiding BCCA research, overseeing requests for data access and speeding research project approval.

The BCCA has ethics approval in each jurisdiction in Australia and New Zealand, and governance approval from participating sites. Patients have the opportunity to opt out of the registry at any time.

2020 Data analyses

Unless stated otherwise, analyses were undertaken on the 2020 dataset. For participation, incidence capture and screening, patients diagnosed with colorectal cancer between 1 January 2020 and 31 December 2020 were analysed. For sections pertaining to pre-surgery demographics, treatment and clinical quality indicators, patients who had surgery between 1 January 2020 and 31 December 2020 were analysed. Throughout the report analyses were undertaken where complete data was available, unless otherwise stated. Where deemed relevant, sections include details about how many treatment episodes (TE) (as opposed to patients) were included in the analysis.

Three year (2018 - 2020) data was used to generate funnel plots to ensure statistical power and relevance. A Funnel Plot is a visual representation of individual units compared to their peers and the overall average; it also identifies those who are performing better or worse than the average. The funnel plot contours represent two standard deviations (95% control limits) and three standard deviations (99.8% control limits) from the mean. Those above and below these lines are considered outliers, with a 5% and 0.2% chance of a false positive.

All units with <10 operations were grouped in a single group (labelled group ZZ). Including the ZZ group there were 101 units analysed. For the 101 units, the median number of patients was 97 (mean 137, range 11- 602 surgeries).

Some funnel plots present unadjusted crude data, while others (where noted) are risk-adjusted. Risk-adjustment considers differences in patient-level risk-factors and enables adjustment for confounding variables which are beyond the control of the surgeon or healthcare system. The risk-adjustment models were revised in December 2018. Variables used in the risk adjustment model are noted under each graph. Clinical input identified the following risk factors: age, sex, ASA grade, urgency of surgery, cancer type and tumour stage. Statistical modelling including the likelihood ratio test was used to identify multivariate and independently significant risk factors. A separate category for missing data was created and included in the model. Units with less than 20% of complete data on endpoint and/or risk factors were not included in the risk adjusted funnel plots. Outliers are represented as coloured dots in the plots.

Colorectal cancer is the second most common cause of cancer death in Australia, resulting in a significant burden of care in the Australian and New Zealand communities.

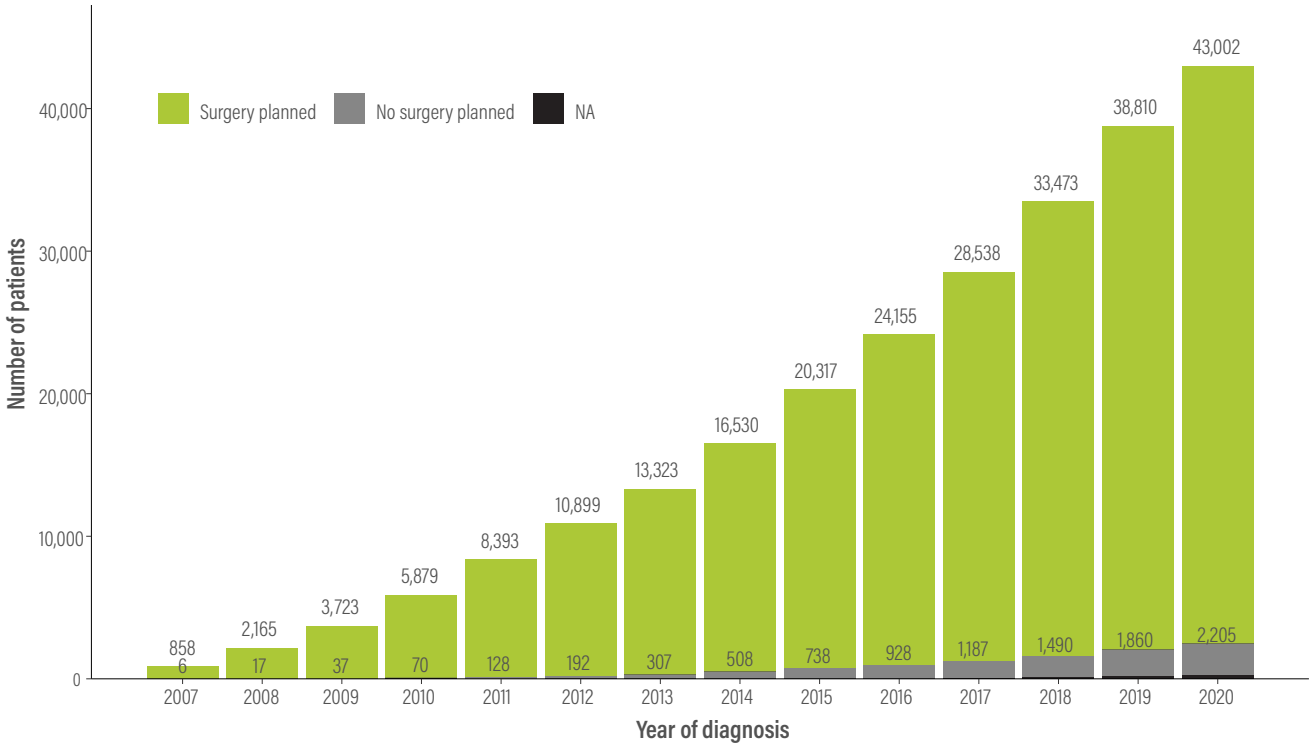
1. PARTICIPATION

Colorectal cancer is the second most common cancer in Australia, resulting in a significant burden of care in the Australian and New Zealand communities. BCCA records information about people newly diagnosed with colorectal cancer, with the aim of improving clinical outcomes.

Participation in the BCCA by clinicians continues to grow. As of 31st December 2020, there were 43,002 patients registered (Figure 1). In previous reports, participation was calculated by surgery year. For this and future reports, participation is presented by diagnosis year. This means that both surgically as well as non-surgically-managed patients recorded in the database are presented, providing a more accurate comparison of BCCA uptake compared with annual colorectal cancer cases diagnosed in Australia and New Zealand (Figure 2).

Cumulative participation (2007-2020)

Figure 1. Cumulative participation of colorectal cancer patients with the BCCA registry



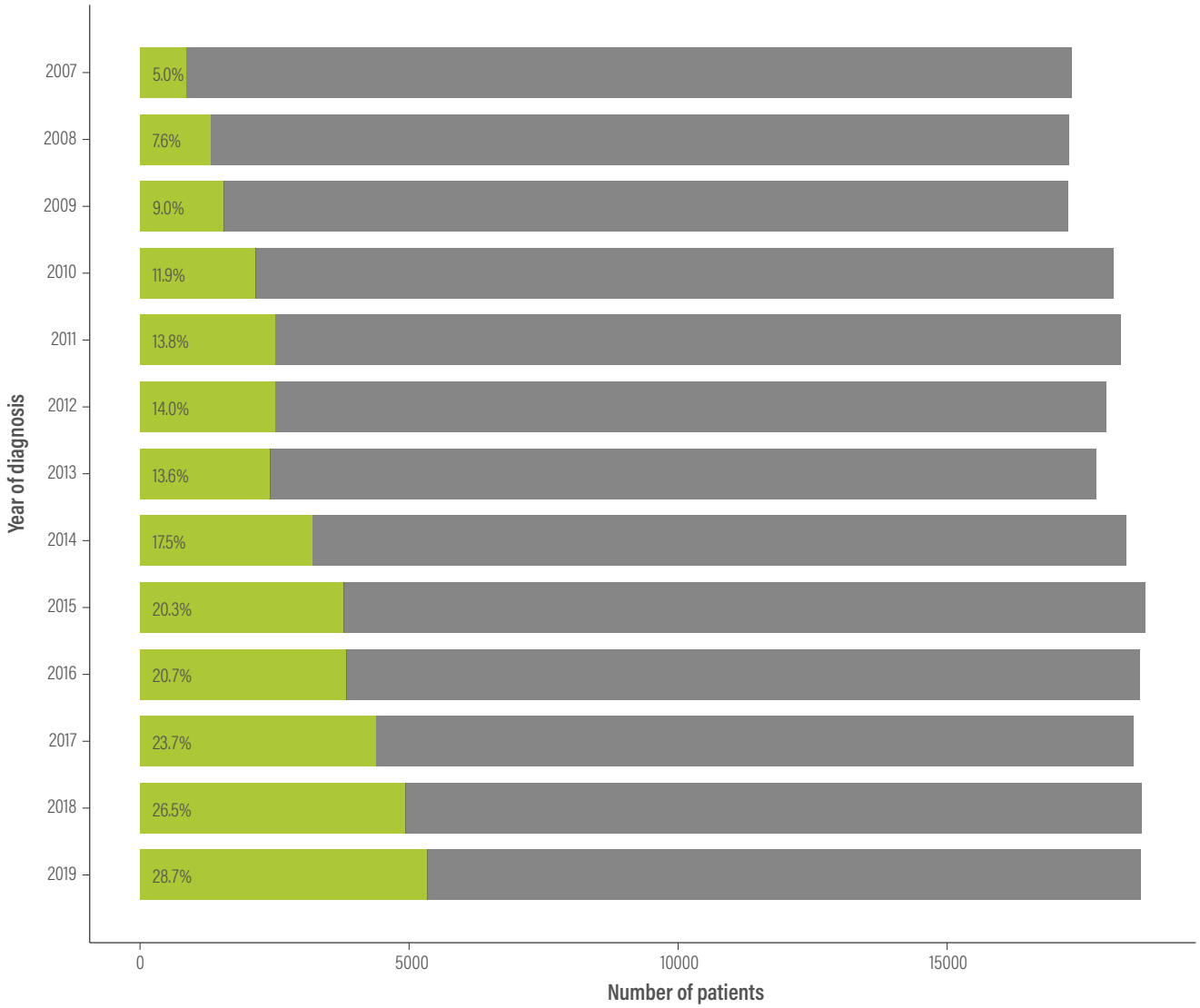
NA: missing surgery status

The total number of patients recorded in the BCCA as of 31st December 2020 was 43,002, of which 2,205 did not have surgery planned. This is an increase from 38,810 patients recorded as of 31st December 2019.

Annual participation

The proportion of people diagnosed with colorectal cancer captured in Australia and New Zealand by the BCCA continues to increase (Figure 2). This reflects both an increase in the annual number of people with colorectal cancer recorded in the BCCA as well as a reduction in the national incidence rate of colorectal cancer, primarily due to the effect of bowel cancer screening[5]. This annual percentage decrease is estimated to be 0.8 to 4.8% per annum for people aged 50-69 years with similar annual decreases for those over 70 years since the mid-1990s. Colon cancer rates for people less than 50 years however have increased from the mid-2000s (from 1.7 – 9.3%).

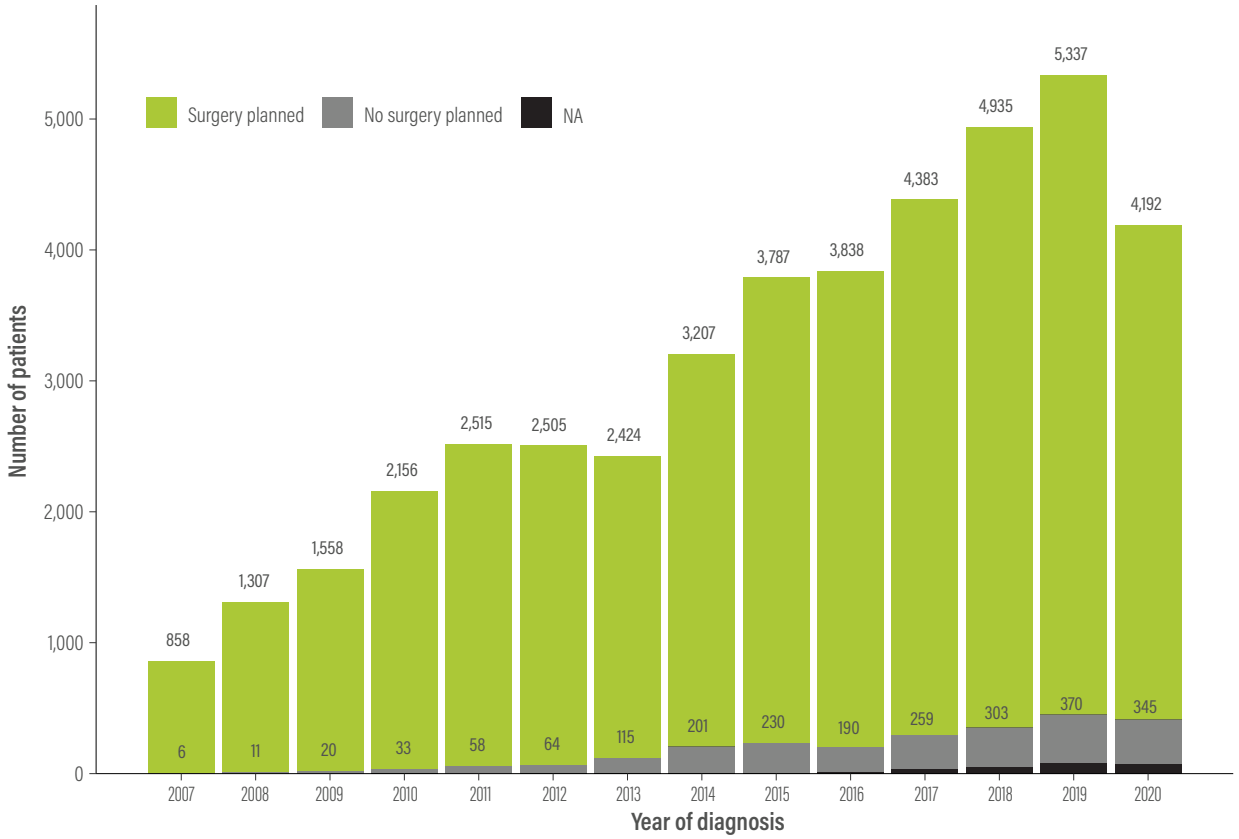
Figure 2. Proportion of Australia and New Zealand colorectal cancer incidents captured by the BCCA registry over time



NA: missing surgery status

Data for Figure 2 are delayed by one year so that the comparison of the BCCA case ascertainment to national incidence data can be accurately assessed. For 2019, the number of colorectal cancer cases recorded in the BCCA was 28.7% of the total incidence of Australian and New Zealand colorectal cancer cases for that year[6-8].

Figure 3. Patients added to registry per year (due to ongoing retrospective data entry at some sites, current year is always lower at census date)



NA: missing surgery status

4,192 new patients were added to BCCA in 2020 (Figure 3), lower than 2019. This may be due to lower presentation of cases due to the impact of COVID 19 during 2020, and/or delayed reporting to the registry. The data cutoff for the BCCA report is at the end of January for the year prior, so each year there are a proportion of cases that do not make the data cut and are entered in the following year's report. Note values reported here for prior years may also be larger than in previous annual reports due to delayed reporting in subsequent years. The annual number of cases registered has been steadily increasing and with over 3,000 patients registered per annum since 2014, and over 4,000 patients registered since 2017.

Three hundred and forty five (8.2%) of the patients diagnosed in 2020 did not have surgery planned. A majority of these were due to the high morbidity/mortality risk associated with surgery. These included patients with stage IV cancer (n=131, 38%), patients deemed medically unfit for surgery (n=48, 14%), and advanced age (n=13, 4%). Twenty four (7%) of patients declined surgery. Patients in the 'Other' category included alternative treatment options (chemoradiotherapy, neoadjuvant therapy) and patient death. There were 70 patients with missing surgery status.

Table 1. Reasons for non-operative management in patients diagnosed with colorectal cancer (2020)

Reason for no surgery	Count	Percentage
Cancer stage IV	131	38%
Polypectomy	54	16%
Medically unfit	48	14%
Patient declined	24	7%
Unresectable	16	5%
Watch and wait	14	4%
Advanced age	13	4%
Stent	1	<1%
Doctor's discretion	0	<1%
Other	43	12%
Unknown	1	<1%
Total	345	100%

Participation by jurisdiction (2020)

Victoria and New South Wales reported the highest volume participation in 2020 followed by Queensland, South Australia and New Zealand (Table 2). Across both countries, 82% of participating cases were from public hospitals (96% for New Zealand, and 78% for Australia). This is a much greater proportion of public sector participation than occurs in practice, reflecting mandatory CSSANZ trainee input to the registry. A future focus of BCCA is identification and recruitment of private sector health services, though funding data entry at these sites remains a challenge.

Table 2. BCCA participation by jurisdiction and public/private hospital (2020)

	Hospital	Count	Percentage
ACT	Private	19	59%
	Public	13	41%
NSW	Private	161	19%
	Public	695	81%
NT	Private	0	0%
	Public	3	100%
NZ	Private	33	3%
	Public	920	97%
QLD	Private	164	29%
	Public	406	71%
SA	Private	73	15%
	Public	415	85%
TAS	Private	28	68%
	Public	13	32%
VIC	Private	243	23%
	Public	796	77%
WA	Private	20	10%
	Public	190	90%

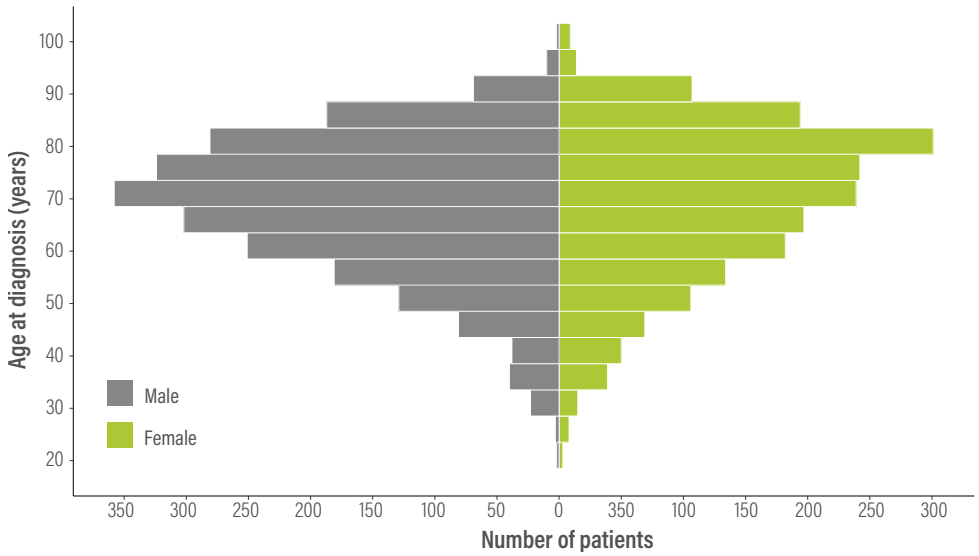
The number of patients under age 50 at time of diagnosis continues to increase, representing 12% of the cohort in 2020.

2. DEMOGRAPHICS

Age and gender characteristics

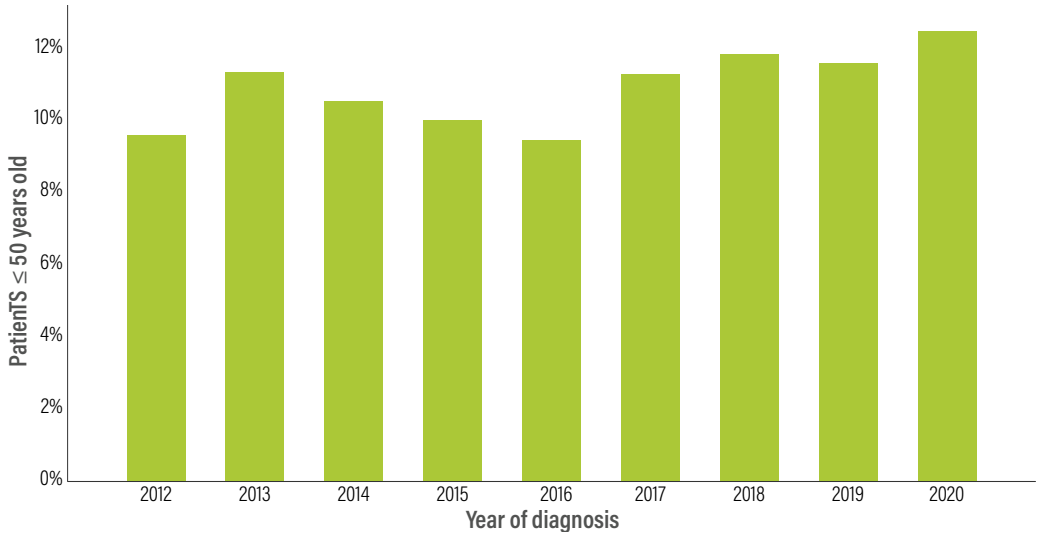
Similar to previous reporting, more males than females were diagnosed with colorectal cancer in 2020 (54% males). Figure 4 shows the proportion of males and females across various age categories and of note demonstrates that overall more females were diagnosed at age above the age of 80 years. The mean age at diagnosis was 69 for males and 68 for females.

Figure 4. Age and gender distribution of patients diagnosed with colorectal cancer in 2020



Patients under age 50 at time of diagnosis continue to increase, representing over 12% of the cohort in 2020 (Figure 5). Recent published literature has reported this cohort of patients have a higher tumour stage at presentation and longer length of hospitalisation[1]. This increase is disproportionate and not merely a result of increased contribution of cases into the registry overall and is a trend observed internationally[9]. In 2020 the Royal Australian College of General Practitioners (RACGP) called for the routine screening age to decrease to 45, similar to recommendations made in 2018 by the American Cancer Society[10, 11].

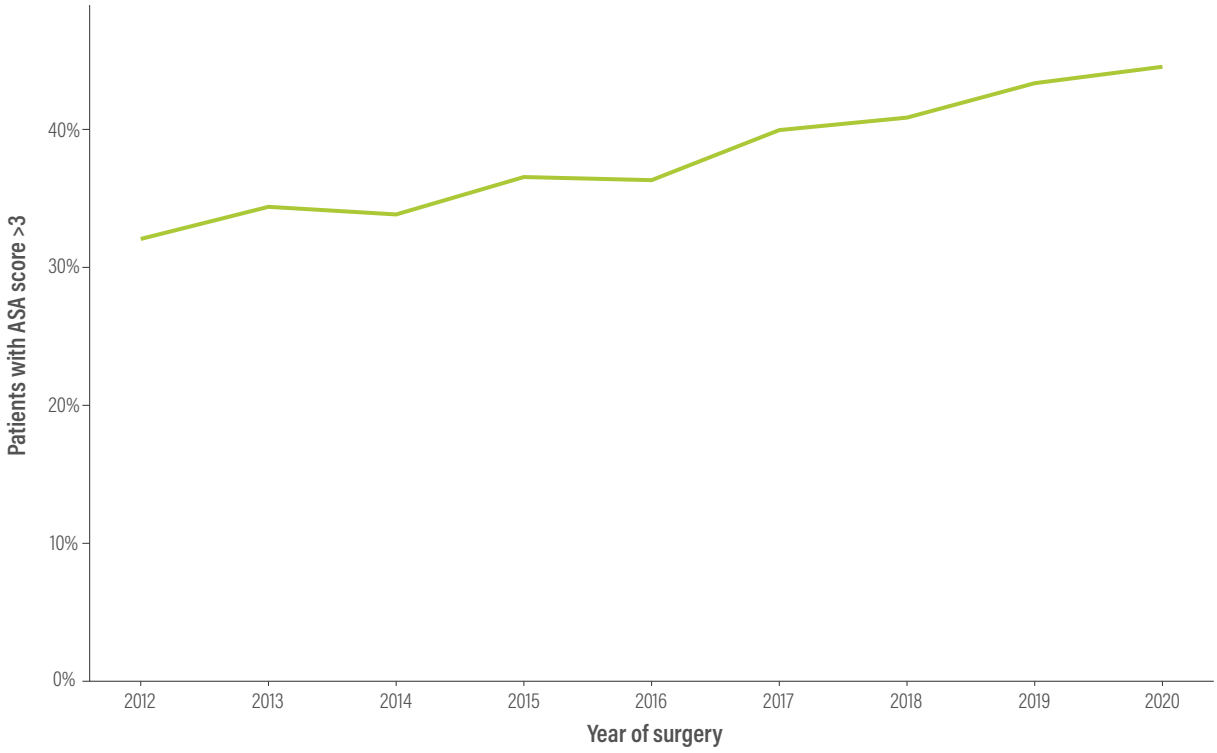
Figure 5. Colorectal cancer patients under 50 years at the time of diagnosis



ASA status

The American Society of Anaesthesiologists Physical (ASA) Classification System[12] is a system for assessing fitness for surgery. Figure 6 shows that patients with an ASA ≥ 3 has continued to increase since 2012 and in 2020 the rate of patients undergoing colorectal surgery with an ASA ≥ 3 was 45%. Despite this, mortality and complication rates are decreasing (see Section 6).

Figure 6. Patients with ASA 3 or greater at the time of surgery



Tumour location

Tumour location is detailed in Table 3. While overall the data are similar to previous years, there has been an increase in the proportion of mid & lower third rectal cancers (1.2% & 1.7% respectively), while conversely the proportion of sigmoid colon cancers has decreased by 2.3%.

Table 3. Primary tumour location of colorectal cancer patients who received surgical treatment in 2020

Tumour site	Count	Percentage
Ascending colon	540	13.1%
Caecum	524	12.7%
Descending colon	178	4.3%
Hepatic flexure	221	5.3%
Rectosigmoid	289	7%
Rectum lower third	628	15.2%
Rectum mid third	397	9.6%
Rectum upper third	159	3.8%
Sigmoid colon	709	17.1%
Splenic flexure	123	3%
Transverse colon	368	8.9%
Total	4136	100%

195 patients excluded due to missing or unknown tumour location.

Colon and rectal cancer profiles

The overall proportion of patients with rectal cancer was 28.6% in 2020. Table 4 reports demographic details, tumour stage and ASA score in patients with colon vs. rectal cancer. It is noted that in the under 50 age group there is a greater proportion of rectal cancer compared to colon cancer (15% cf 9.2%).

Table 4. Description by cancer type

	Overall, N = 41361	Colon, N = 29521	Rectal, N = 11841
Sex			
Female	2,258 (55%)	1,524 (52%)	734 (62%)
Male	1,878 (45%)	1,428 (48%)	450 (38%)
Age at diagnosis			
<50 yrs	446 (11%)	272 (9.2%)	174 (15%)
50-64 yrs	1,138 (28%)	703 (24%)	435 (37%)
65-74 yrs	1,146 (28%)	812 (28%)	334 (28%)
75-84 yrs	1,046 (25%)	857 (29%)	189 (16%)
85+ yrs	360 (8.7%)	308 (10%)	52 (4.4%)
T stage			
T0	178 (4.4%)	78 (2.7%)	100 (8.7%)
Tis	430 (11%)	285 (9.9%)	145 (13%)
T1	667 (17%)	405 (14%)	262 (23%)
T2	1,854 (46%)	1,342 (47%)	512 (44%)
T3	824 (20%)	726 (25%)	98 (8.5%)
T4	60 (1.5%)	34 (1.2%)	26 (2.3%)
TX	25 (0.6%)	16 (0.6%)	9 (0.8%)
Unknown	98	66	32
N stage			
N0	2,423 (60%)	1,721 (60%)	702 (61%)
N1	1,026 (25%)	738 (26%)	288 (25%)
N2	508 (13%)	398 (14%)	110 (9.6%)
NX	69 (1.7%)	21 (0.7%)	48 (4.2%)
Unknown	110	74	36

	Overall, N = 4,1361	Colon, N = 2,9521	Rectal, N = 1,1841
M stage			
M0	3,026 (75%)	2,133 (74%)	893 (78%)
M1	399 (9.9%)	307 (11%)	92 (8.0%)
MX	587 (15%)	429 (15%)	158 (14%)
Unknown	124	83	41
Overall stage*			
0	193 (4.8%)	86 (3.0%)	107 (9.4%)
I	906 (23%)	586 (20%)	320 (28%)
II	1,252 (31%)	985 (34%)	267 (23%)
III	1,223 (30%)	881 (31%)	342 (30%)
IV	399 (10.0%)	307 (11%)	92 (8.0%)
X	37 (0.9%)	22 (0.8%)	15 (1.3%)
Unknown	126	85	41
ASA score			
1	388 (9.5%)	268 (9.2%)	120 (10%)
2	1,832 (45%)	1,231 (42%)	601 (51%)
3	1,703 (42%)	1,277 (44%)	426 (36%)
4	171 (4.2%)	145 (5.0%)	26 (2.2%)
5	1 (<0.1%)	1 (<0.1%)	0 (0%)
Unknown	41	30	11

195 patients excluded due to missing cancer type

*The AJCC staging system is a classification system developed by the American Joint Committee on Cancer (AJCC) for describing the extent of disease progression in cancer patients. It utilises the TNM scoring system to calculate an overall stage value, where T is Tumour size, N is Lymph nodes affected, and M is Metastases. Tumour stages: Stage 0 (cancer in situ), Stage I, II (local disease), Stage III (nodal spread) Stage IV (metastatic disease) and Stage X (tumour stage cannot be identified).

Urgency of hospital admission

The majority of patients presented electively in 2020 (83%). This is marginally lower than 2019 (85%). Of note, the proportion of patients presenting as an emergency increased from 7.8% in 2019 to 9.4% in 2020 (Table 5). Female patients presented more frequently as an emergency case than males (55% vs 45%).

Table 5. Description by urgency of hospital admission

	Overall, N = 4,3191	Elective, N = 3,5951	Urgent, N = 3171	Emergency, N = 4071
Sex				
Female	2,356 (55%)	1,964 (55%)	170 (54%)	222 (55%)
Male	1,963 (45%)	1,631 (45%)	147 (46%)	185 (45%)
Age at diagnosis				
<50 yrs	463 (11%)	365 (10%)	32 (10%)	66 (16%)
50-64 yrs	1,169 (27%)	972 (27%)	84 (26%)	113 (28%)
65-74 yrs	1,217 (28%)	1,048 (29%)	76 (24%)	93 (23%)
75-84 yrs	1,087 (25%)	916 (25%)	84 (26%)	87 (21%)
85+ yrs	383 (8.9%)	294 (8.2%)	41 (13%)	48 (12%)
Cancer site				
Caecum/ascending colon	1,063 (31%)	890 (31%)	86 (35%)	87 (31%)
Hepatic flexure	221 (6.5%)	181 (6.2%)	17 (6.8%)	23 (8.3%)
Transverse colon	368 (11%)	276 (9.5%)	47 (19%)	45 (16%)
Splenic flexure/descending colon	299 (8.7%)	207 (7.1%)	31 (12%)	61 (22%)
Rectosigmoid	289 (8.4%)	229 (7.9%)	29 (12%)	31 (11%)
Rectal	1,183 (35%)	1,114 (38%)	39 (16%)	30 (11%)
Unknown	896	698	68	130
N stage				
N0	2,423 (60%)	2,423 (60%)	1,721 (60%)	702 (61%)
N1	1,026 (25%)	1,026 (25%)	738 (26%)	288 (25%)
N2	508 (13%)	508 (13%)	398 (14%)	110 (9.6%)
NX	69 (1.7%)	69 (1.7%)	21 (0.7%)	48 (4.2%)
Unknown	110	110	74	36
T stage				
T0	182 (4.4%)	177 (5.2%)	2 (0.7%)	3 (0.8%)
Tis	434 (11%)	423 (12%)	5 (1.7%)	6 (1.6%)
T1	674 (16%)	645 (19%)	15 (5.0%)	14 (3.6%)
T2	1,870 (46%)	1,585 (46%)	132 (44%)	153 (40%)
T3	844 (21%)	517 (15%)	130 (43%)	197 (51%)
T4	70 (1.7%)	43 (1.3%)	14 (4.7%)	13 (3.4%)
TX	26 (0.6%)	25 (0.7%)	1 (0.3%)	0 (0%)
Unknown	219	180	18	21

	Overall, N = 4,3191	Elective, N = 3,5951	Urgent, N = 3171	Emergency, N = 4071
N stage				
N0	2,452 (60%)	2,160 (63%)	129 (44%)	163 (43%)
N1	1,035 (25%)	835 (25%)	84 (28%)	116 (30%)
N2	516 (13%)	360 (11%)	67 (23%)	89 (23%)
NX	81 (2.0%)	51 (1.5%)	16 (5.4%)	14 (3.7%)
Unknown	235	189	21	25
M stage				
M0	3,067 (75%)	2,672 (79%)	201 (67%)	194 (50%)
M1	411 (10%)	253 (7.5%)	75 (25%)	83 (22%)
MX	595 (15%)	462 (14%)	24 (8.0%)	109 (28%)
Unknown	246	208	17	21
Overall stage*				
0	198 (4.9%)	189 (5.6%)	5 (1.7%)	4 (1.0%)
I	916 (23%)	884 (26%)	15 (5.0%)	17 (4.4%)
II	1,271 (31%)	1,022 (30%)	108 (36%)	141 (37%)
III	1,235 (30%)	1,011 (30%)	93 (31%)	131 (34%)
IV	411 (10%)	253 (7.5%)	75 (25%)	83 (22%)
X	40 (1.0%)	27 (0.8%)	3 (1.0%)	10 (2.6%)
Unknown	248	209	18	21
ASA score				
1	413 (9.7%)	348 (9.8%)	25 (8.0%)	40 (9.9%)
2	1,928 (45%)	1,670 (47%)	125 (40%)	133 (33%)
3	1,752 (41%)	1,439 (41%)	139 (45%)	174 (43%)
4	176 (4.1%)	96 (2.7%)	21 (6.8%)	59 (15%)
5	1 (<0.1%)	0 (0%)	1 (0.3%)	0 (0%)
Unknown	49	42	6	1

Since the National Bowel Cancer Screening Program began in August 2006, around 6.8 million screening tests have been completed.

AIHW 2020

3. SCREENED VS NON-NBCSP SCREENED CANCERS

Screening (testing of asymptomatic persons) for colorectal cancer using the Faecal Occult Blood Test (FOBT) was introduced in Australia in 2006, after an initial pilot study between 2002 and 2004. There has been an incremental rollout of the National Bowel Cancer Screening program (NBCSP) which is now complete, and invites all Australians aged 50-74 to complete screening biannually. Australians between 50 and 74 years of age at average risk and without symptoms are mailed an immunological FOBT every 2 years, equating to approximately 5 million Australians screened per year.

The National Bowel Cancer Screening Program Monitoring report was published in July 2020. Since the program began in August 2006, around 6.8 million NBCSP screening tests have been completed. Of the 5 million people invited to screen between January 2017 and December 2018, 42% participated. Of those assessed in 2018 after a positive screen, 1 in 30 were diagnosed with a confirmed or suspected cancer[13].

In New Zealand, a pilot program was carried out by the Waitemata District Health Board between 2011 and 2017. As of January 2018, the new National Bowel Screening Programme (NBSP), commenced a staged rollout across health boards for eligible New Zealanders aged 60 to 74, with FOBT screening every 2 years, which is expected to be completed by 2021. The New Zealand National program is in its infancy but based on their pilot program they are predicting a 7% positivity rate, with 700,000 people being invited per year, once the program is fully rolled out, and initial detection rates estimated at 500-700 cancers each year.

A subset of patients from each national screening program are submitted to the BCCA thus the data presented below includes patients from bowel cancer screening programs in both Australia and New Zealand. It includes patients who have had screening tests outside of the screening programs, and patients who were diagnosed without screening. It is reassuring to note that the proportion of patients diagnosed following FOBT has increased from 12% in 2012 to 18% in 2020 (Table 6), which is a slight reduction from 2019, and it is expected this percentage will increase as the screening programs are fully implemented in both countries and efforts to improve screening compliance materialise.

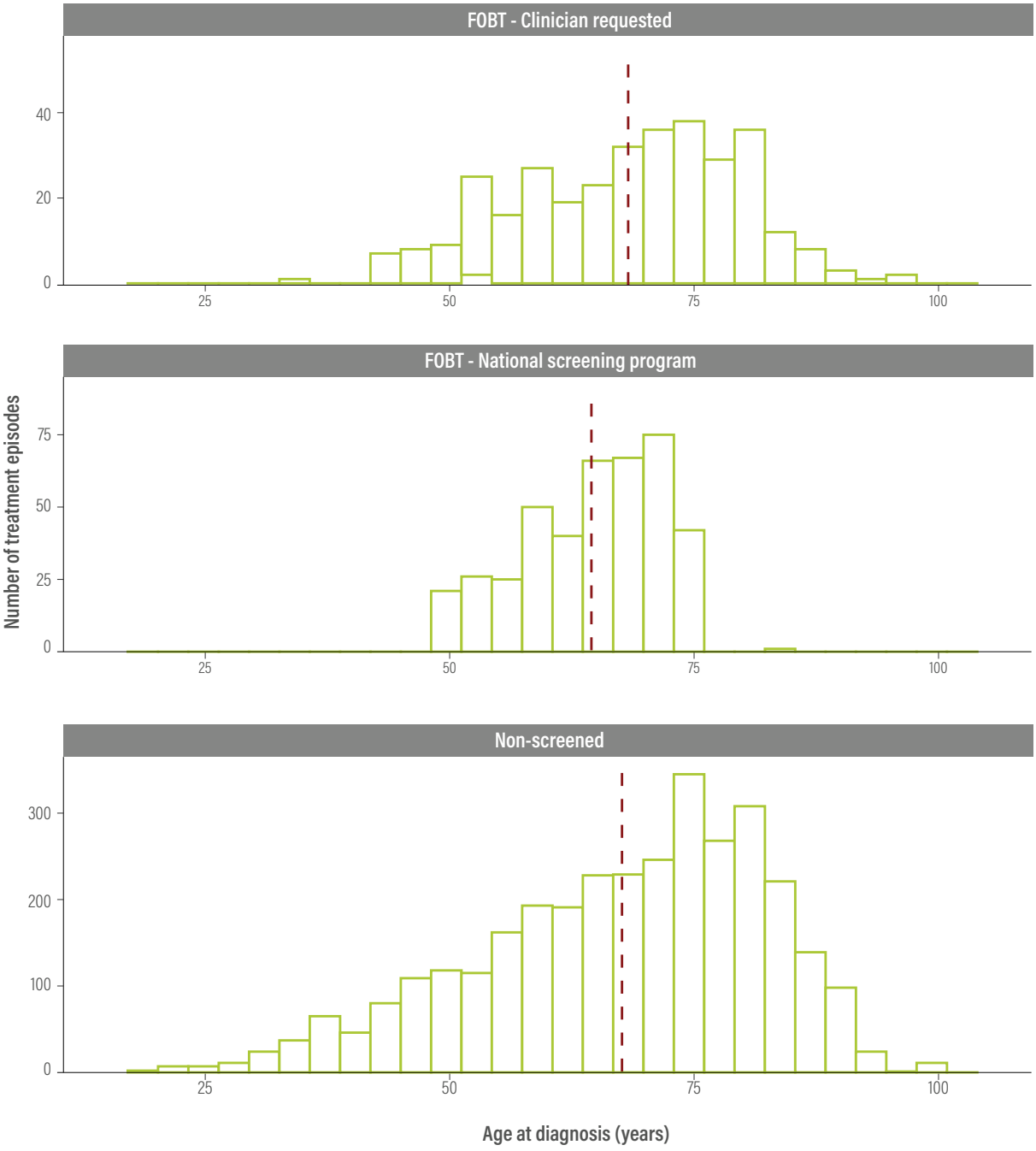
Table 6. Cumulative incidence and proportion of patients diagnosed by FOBT

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Diagnosed following FOBT	12%	11%	12%	11%	14%	16%	18%	19%	18%
Count	1,409	1,892	2,585	3,204	3,233	3,743	4,389	4,842	3,890

Characteristics of patients diagnosed by screening vs. symptoms

Mean age at diagnosis is earlier for patients participating in the NBCSP (64.2 years), than for those screened outside of the program (69.9 years) or for those diagnosed without screening (68.4 years) (Figure 7).

Figure 7. Age distribution of screened vs non FOBT-screened patients



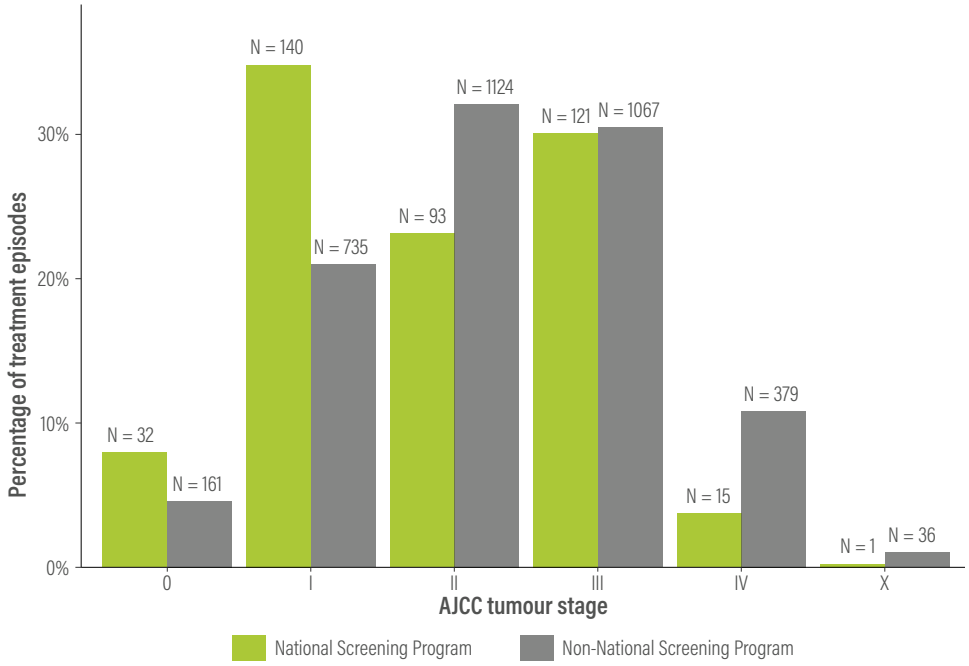
Vertical dashed lines represent average age within each category

Cancer stage

Patients diagnosed via the NBCSP are at an earlier stage than non screened patients (Figure 8). This is expected, and highlights the significant value of the NBCSP. It is difficult to draw conclusions about patients diagnosed by FOBT requested by clinicians as though they do appear to be diagnosed at an earlier stage, it is unknown if they were asymptomatic or symptomatic.

Diagnosis at an earlier stage has been previously shown to be associated with reduced colorectal cancer related mortality[14, 15].

Figure 8. NBCSP patients vs. unscreened patients by cancer stage. Early stage diagnosis is strongly linked to survival



Efficacy of FOBT screening

Differences between proportion of tumour stages across two screening categories (national FOBT screening program vs non-national FOBT-screened colorectal cancer) was tested using the Chi-square goodness of fit (Table 7).

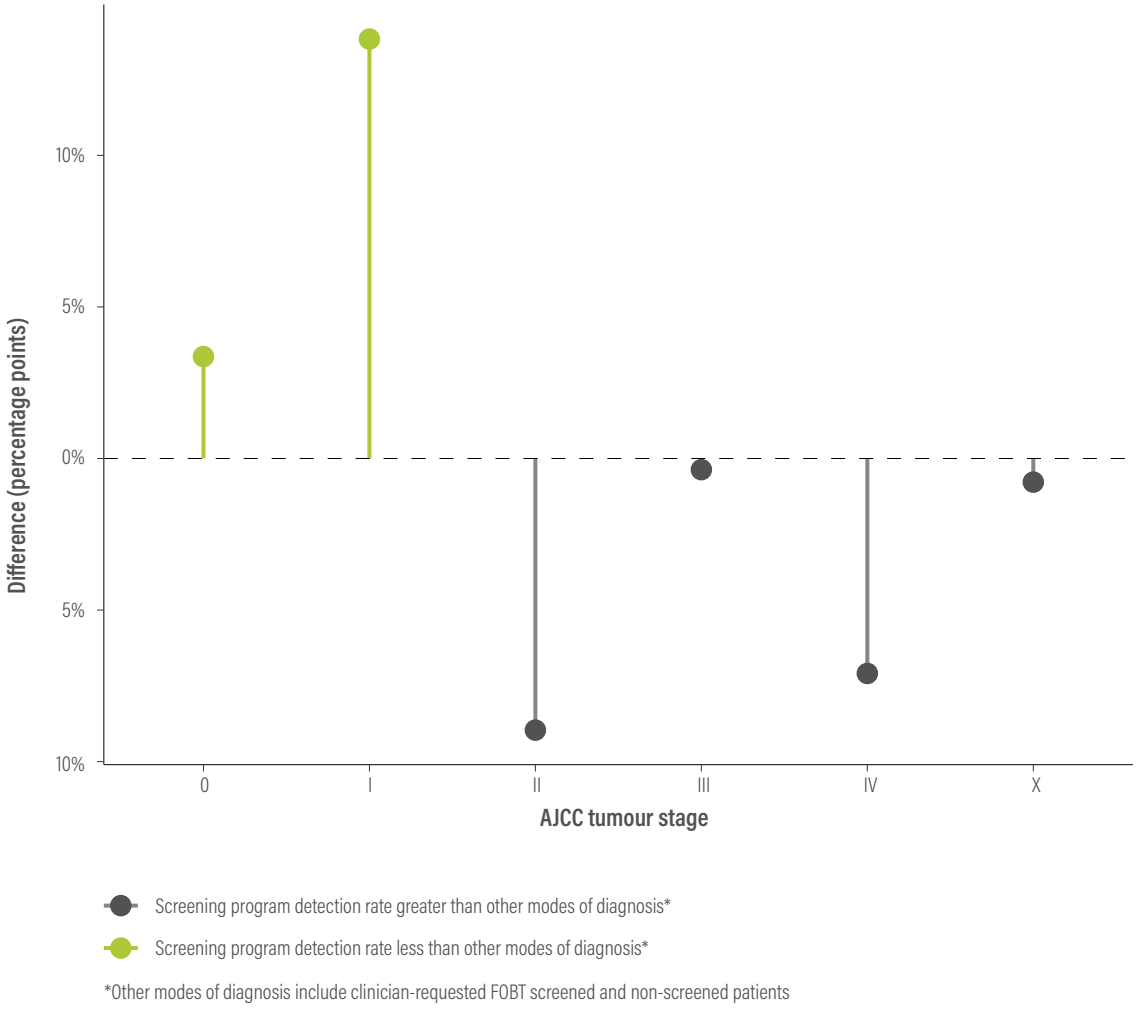
Table 7. Tumour stage of patients diagnosed with colorectal cancer by the national FOBT screening program vs non-screened (2020)

	FOBT - Clinician requested	FOBT - National screening program	Non-screened	Unknown	Total	p-value*
AJCC tumour stage						<0.001
0	16 (0.4%)	32 (0.7%)	145 (3.3%)	5 (0.1%)	198 (4.6%)	
I	112 (2.6%)	140 (3.2%)	623 (14%)	42 (1.0%)	917 (21%)	
II	82 (1.9%)	93 (2.1%)	1,042 (24%)	59 (1.4%)	1,276 (29%)	
III	97 (2.2%)	121 (2.8%)	970 (22%)	48 (1.1%)	1,236 (29%)	
IV	11 (0.3%)	15 (0.3%)	368 (8.5%)	18 (0.4%)	412 (9.5%)	
X	4 (<0.1%)	1 (<0.1%)	32 (0.7%)	4 (<0.1%)	41 (0.9%)	
Unknown	8 (0.2%)	11 (0.3%)	105 (2.4%)	127 (2.9%)	251 (5.8%)	
Total	330 (7.6%)	413 (9.5%)	3,285 (76%)	303 (7.0%)	4,331 (100%)	

*Pearson's Chi -squared test

Figure 9 illustrates the differences between the proportion of patients in the two screening categories (national FOBT screening program vs non-national FOBT-screened colorectal cancers) across different tumour stages. A positive value represents a higher proportion of patients in the national FOBT screening program compared with the other. Cancers diagnosed at the stage I were more than 15% higher in the national FOBT screening program.

Figure 9. Difference in proportion of colorectal cancer patients diagnosed in the national FOBT screening program and outside the national FOBT-screening programs (2020)



*Other modes of diagnosis include clinician-requested FOBT screened and non-screened patients

A recent publication in the Medical Journal Of Australia utilizing data from the BCCA assessed the short and medium term benefits of the Australian colorectal cancer screening program. Patients whose tumours were identified through the NBCSP had a lower long term mortality but also demonstrated a reduction in short term postoperative morbidity[2].

4. MANAGEMENT

Surgery is the primary treatment modality for most patients treated for colorectal cancer treated with curative intent, however, a significant proportion of rectal cancer patients also require preoperative neoadjuvant treatment. This report is divided into the following sections.

1. Colon cancer
   a. Primary procedure
   b. Operative approach
   c. Adjuvant therapy
2. Rectal cancer
   a. MRI utilisation
   b. MDT utilisation
   c. Neoadjuvant therapy
   d. Primary procedure
   e. Operative approach

Colon Cancer

Primary procedures for colon cancer

Right hemicolectomy remains the most commonly performed surgical procedure for colon cancer, accounting for 48% of operations (Table 8).

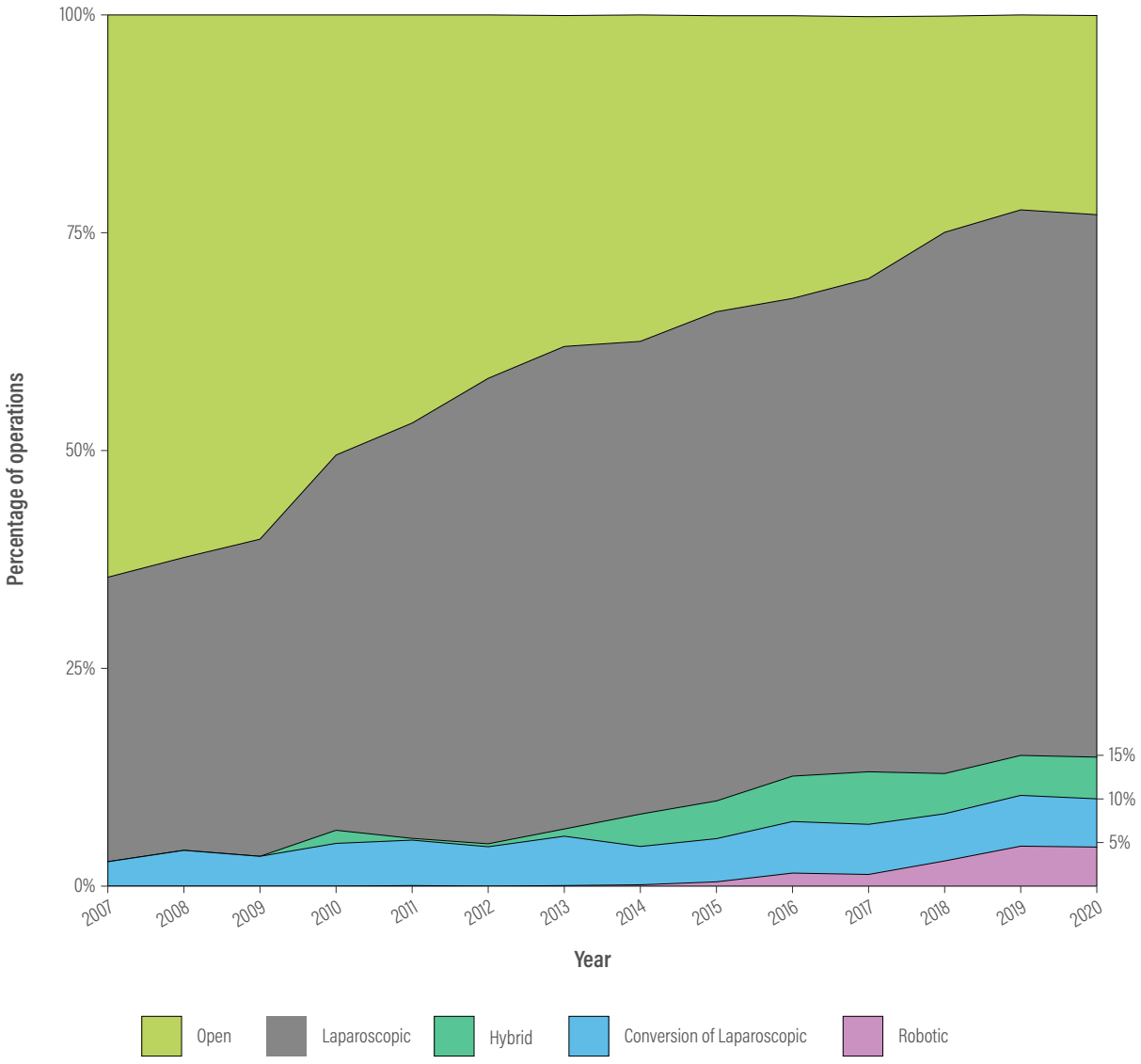
Table 8. Primary procedure for colon cancer patients who received surgical treatment in 2020

Operation	Count	Percentage
Right hemicolectomy	1,270	48%
Extended right hemicolectomy	244	9%
Left hemicolectomy	158	6%
Sigmoid colectomy	16	1%
Total colectomy	42	2%
Sub total colectomy	134	5%
Proctocolectomy	6	<1%
High anterior resection (10.1-15 cm)	690	26%
Transverse colectomy	35	1%
Laparotomy	16	1%
Other	36	1%
Total	2,647	100%

Operative approach for colon cancer

The adoption of minimally invasive surgery (MIS) for colon cancer has now stabilised, after several years of progressive increases in adoption (Figure 10). This is likely due to MIS techniques reaching maturity, and increased recognition that technique selection should be targeted and tailored to patient and disease presentation.

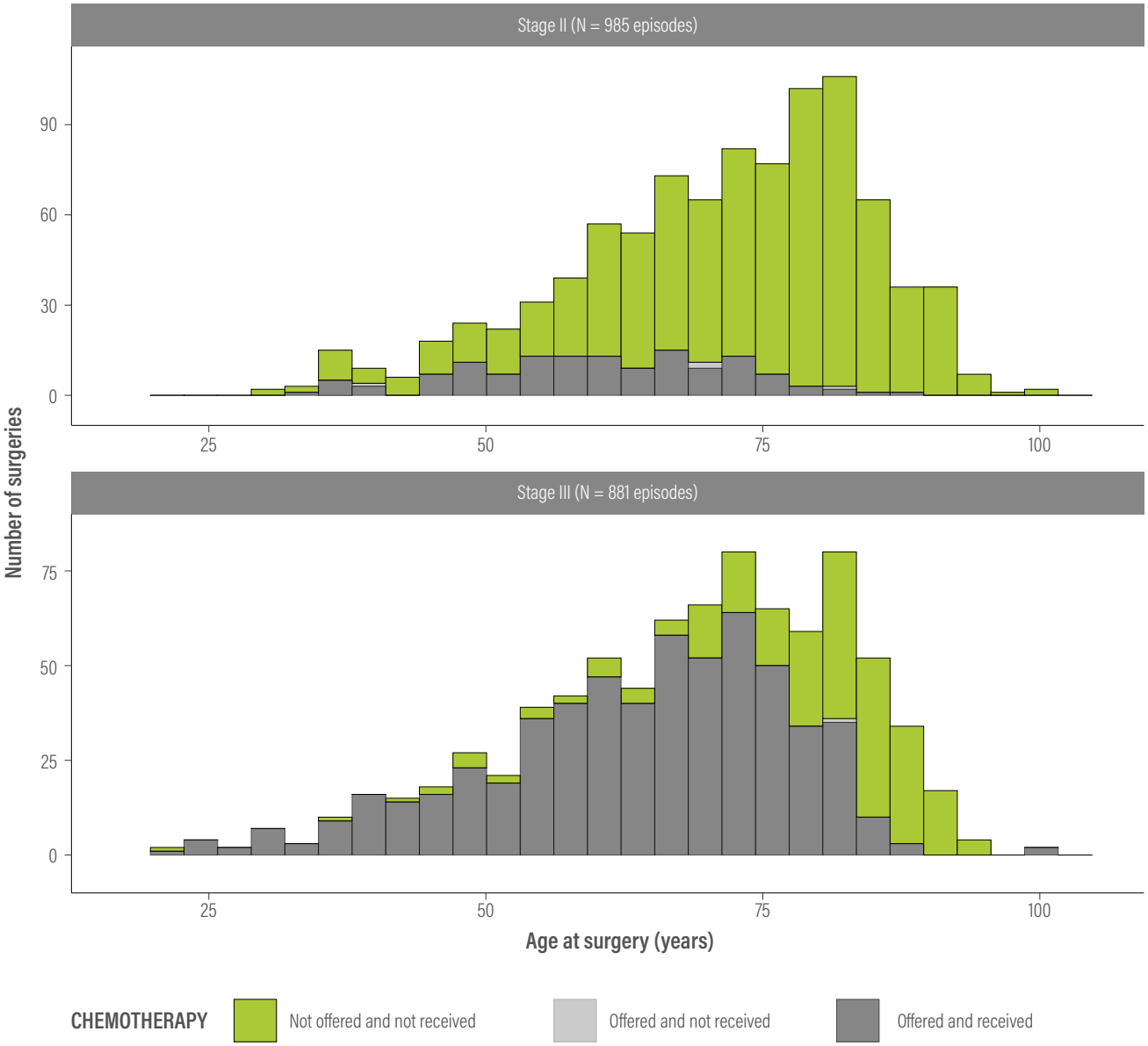
Figure 10. Operative approach for colon cancer patients who received surgical treatment



Adjuvant therapy for colon cancer

Adjuvant therapy with chemotherapy is an important component of the management of patients with advanced colorectal cancer. It is not required in all patients but is often recommended in colon cancer patients with stage III disease and in selected patients with high-risk stage II disease, following resection of the primary tumour. Figure 11 demonstrates adjuvant therapy utilisation in colon cancer patients with stage II and stage III disease. Fourteen percent of Stage II patients were offered chemotherapy. Fourteen percent of stage II and 66% of stage III patients received chemotherapy. Less than 1 percent of Stage III patients were offered but did not receive chemotherapy.

Figure 11. Age distribution of stage II and stage III colon cancer patients who received surgical treatment in 2020, stratified by chemotherapy treatment status



Rectal cancer

Management of rectal cancer is frequently multimodal and requires multidisciplinary input, including preoperative chemoradiation in a significant percentage of patients. Quality indicators for treatment of rectal cancer include preoperative imaging with MRI to allow preoperative assessment of patients for neoadjuvant treatment, and discussion at multidisciplinary team (MDT) meetings.

Figures 12 - 14 and Table 9 demonstrates that most patients are appropriately preoperatively staged using either MRI and are discussed at MDT, however there is still room for improvement, with some low volume centers and one high volume center still having MDT discussion rates of 50% or less (Figure 14).

Rectal cancer patients undergoing MRIs

Figure 12. Proportion of patients with rectal cancer undergoing MRI scan as part of preoperative staging over time

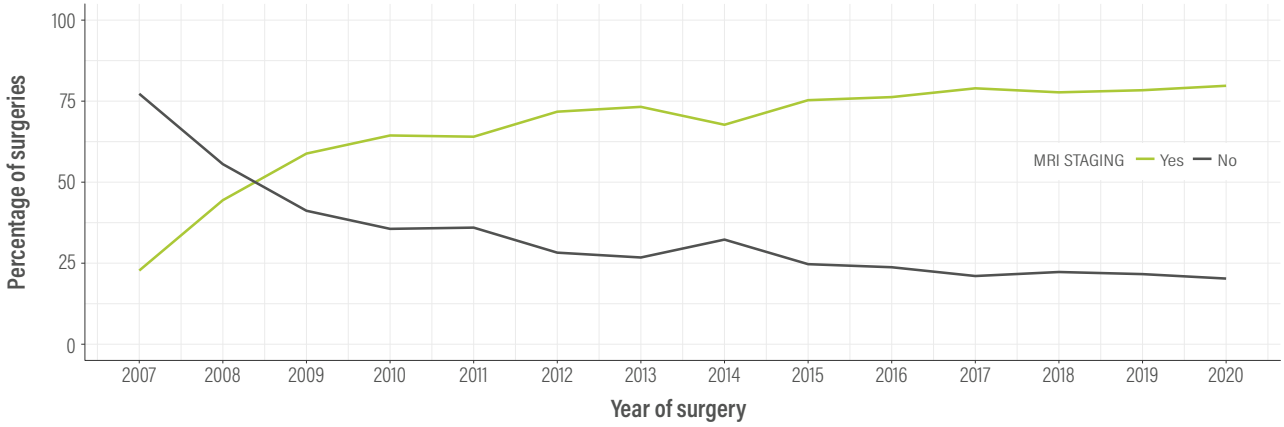
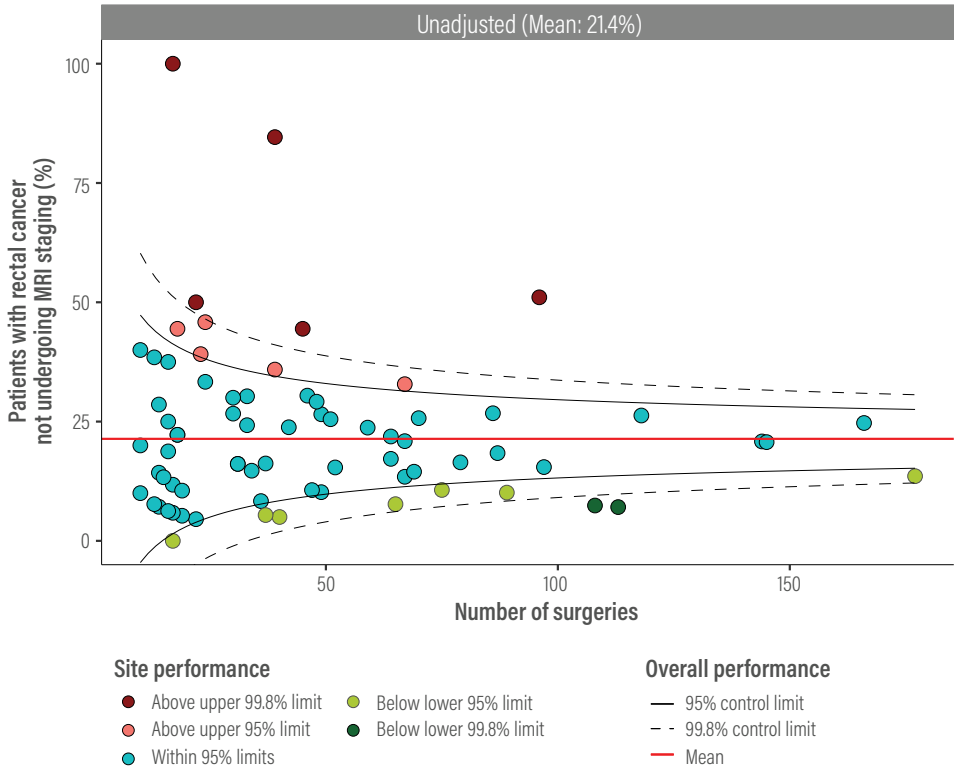


Figure 13. Proportion of rectal cancer patients who received surgical treatment between 2018 and 2020, but did not receive any MRI staging

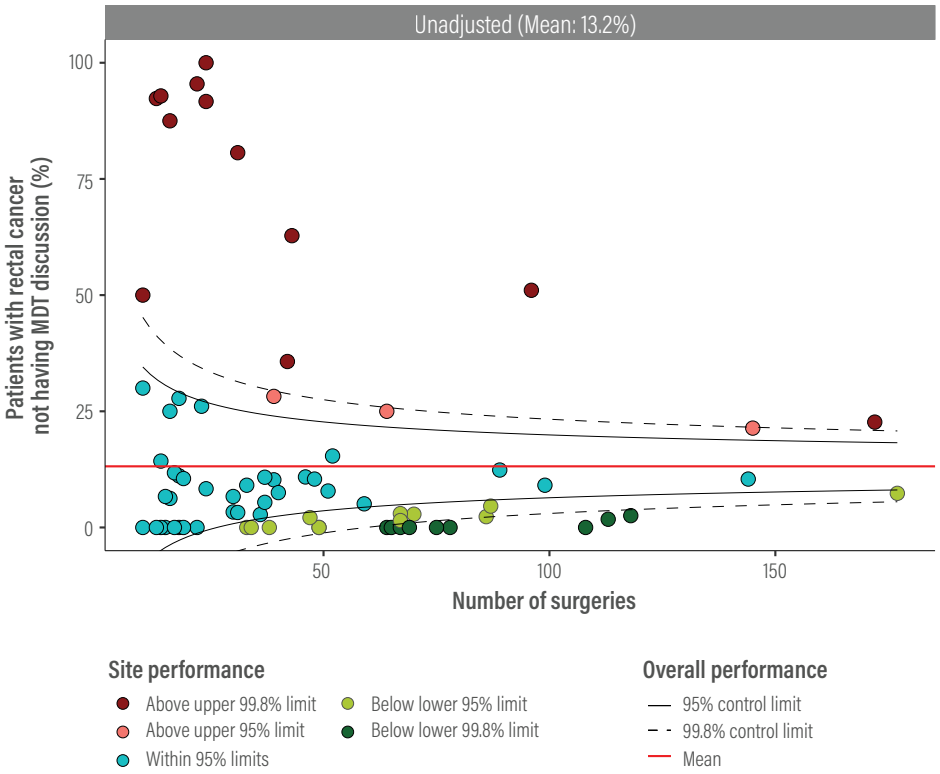


Rectal cancer discussed at MDT

Table 9. Patients with rectal cancer discussed at MDT

Discussed at MDT	Count	Percentage
Yes	1,022	87%
No	143	12%
N/A	11	1%
Total	1,176	100%

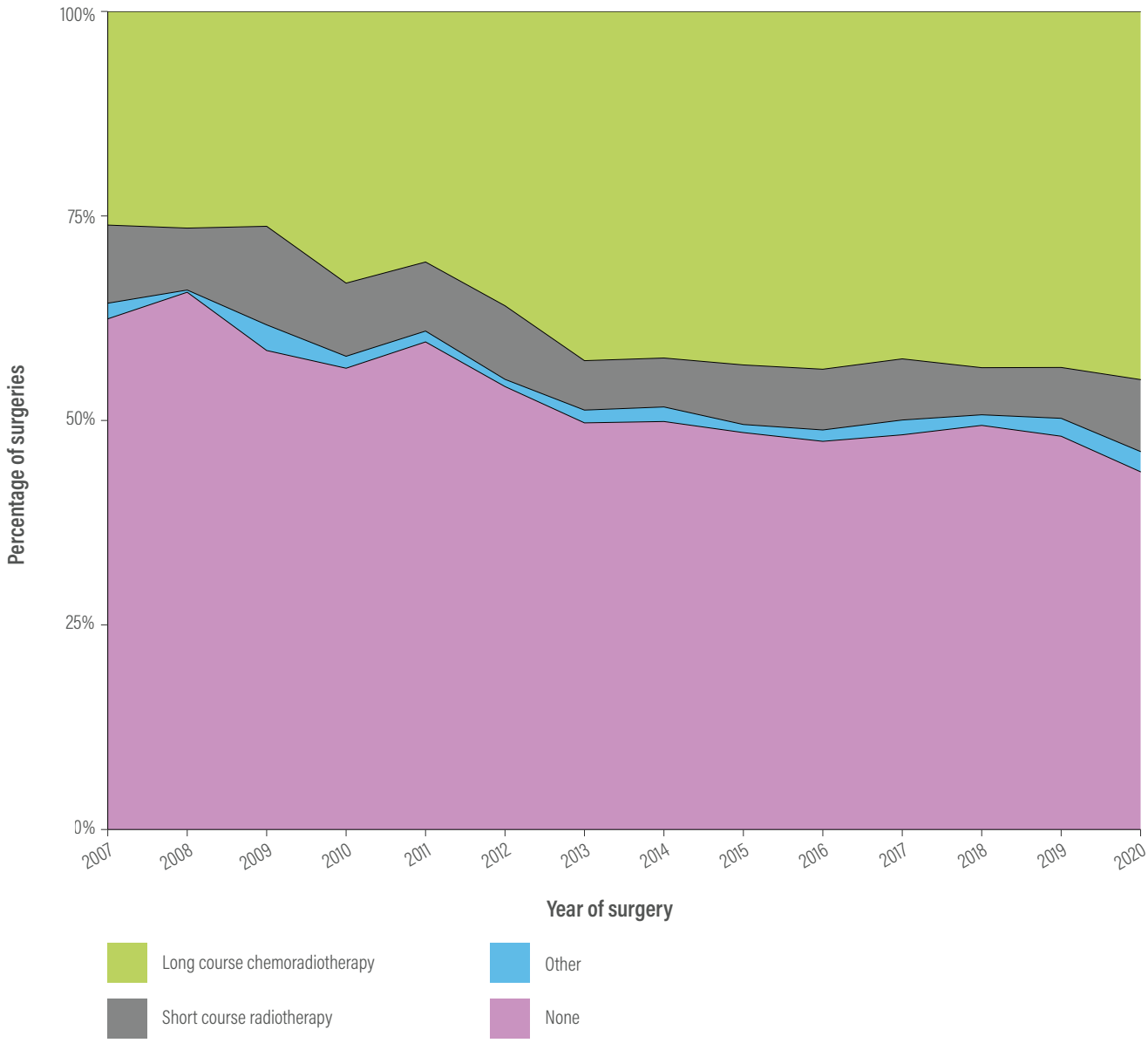
Figure 14. Rate of rectal cancer patients who received surgical treatment between 2018 and 2020 not discussed at MDT, by site



Neoadjuvant therapy

Figure 15 demonstrates that more than 50% of patients with rectal cancer receive neoadjuvant therapy. This includes all patients including those with high rectal cancer and patients with early-stage disease, for whom neoadjuvant treatment is not typically indicated. The most commonly used regimen remains long course chemoradiotherapy.

Figure 15. Neoadjuvant therapy in rectal cancer



Primary procedures for rectal cancer

Ultra low anterior resection remains the most commonly performed surgical procedure for rectal cancer, accounting for 43% of all operations (Table 10).

Table 10. Primary procedure for rectal cancer patients who received surgical treatment in 2020

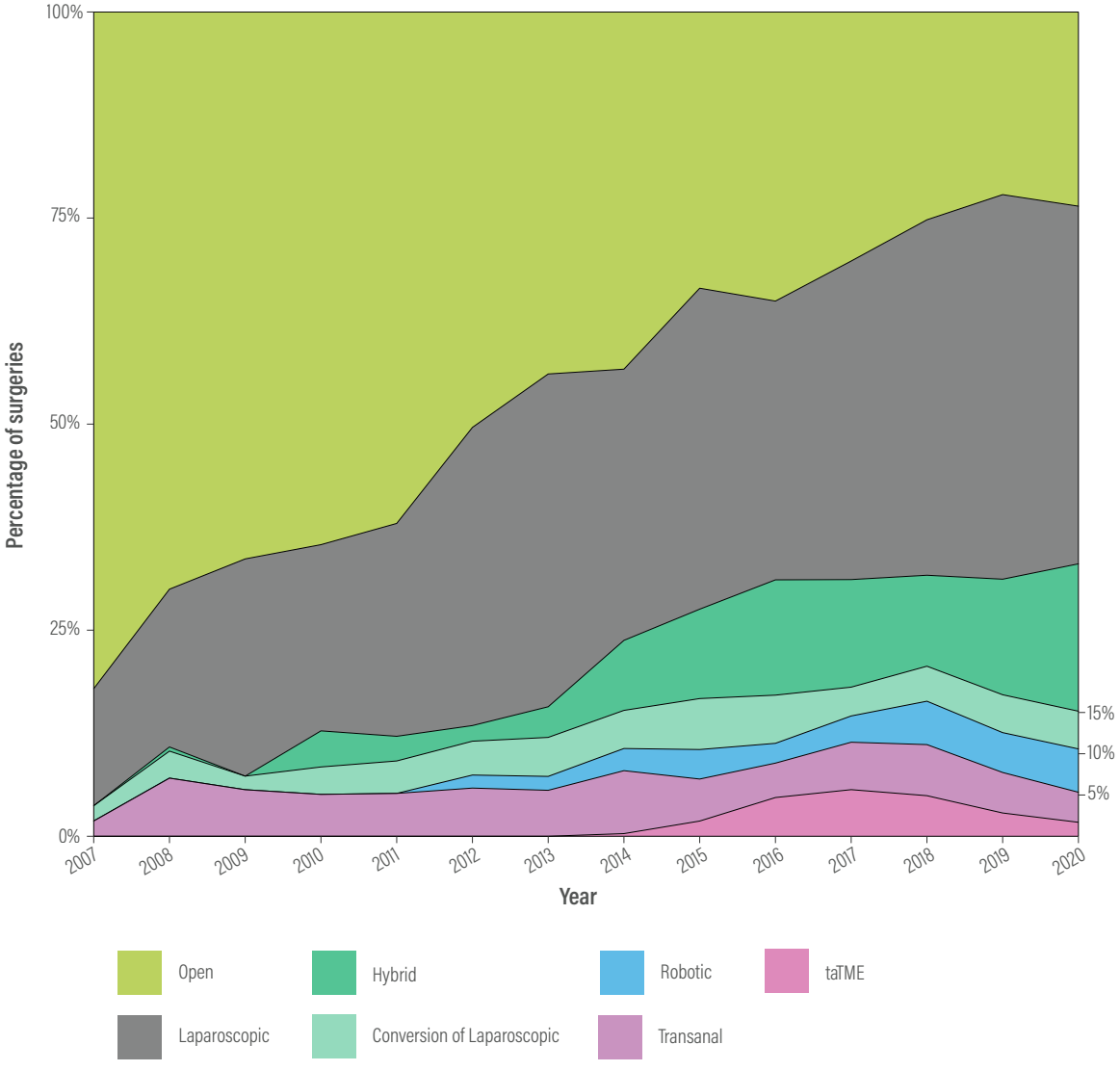
Operation	Count	Percentage
Ultra low anterior resection (0-6 cm)	496	43%
APR*	248	21%
Low anterior resection (6.1-10 cm)	216	19%
High anterior resection (10.1-15 cm)	49	4%
Other	41	4%
TEMS/TAMIS*	38	3%
Hartmanns	30	3%
Colo-anal anastomosis	14	1%
Local excision	12	1%
Proctocolectomy	10	1%
Laparotomy	5	<1%
Total	1,159	100%

*APR (abdominoperineal resection); TEMS (transanal endoscopic microsurgery); TAMIS (transanal minimally invasive surgery)

Operative approach for rectal cancer

The adoption of minimally invasive surgery (MIS) for rectal cancer has now stabilised, after several years of progressive increases in adoption, with a small increase in hybrid approach surgery versus straight laparoscopy (Figure 16). Adoption of newer MIS approaches such as robotic resection and transanal total mesorectal excision (taTME) has also stabilised. This is likely due to MIS techniques reaching maturity, and increased recognition that technique selection should be targeted and tailored to patient and disease presentation.

Figure 16. Operative approach for rectal cancer patients who received surgical treatment



5. COMPLICATIONS

A summary of complications for patients undergoing colonic and rectal cancer operations is shown in Tables 11 and 12 respectively. General trends for medical and surgical complications from 2012 to 2020 are shown in Figure 17. Data in these tables and figures should be interpreted with caution due to the self-reported nature of the data and absence of risk stratification. The complication rates are broadly consistent with international standards. The anastomotic leak rate for colonic (2%) and rectal (3%) resections remains low.

Colon cancer

Table 11. Summary of surgical and medical complications of colon cancer patients who received surgical treatment in 2020

Complication	Count	Percentage
Surgical complications	**583**	**20%**
Abdominal pelvic collection	57	2%
Anastomotic leak	71	2%
Enterocutaneous fistula	5	<1%
Superficial wound dehiscence	51	2%
Deep wound dehiscence	18	1%
Wound infection	118	4%
Sepsis	44	1%
Prolonged ileus	254	9%
Small bowel obstruction	24	1%
Urinary retention	25	1%
Ureteric injury	5	<1%
Splenectomy	1	<1%
Postoperative haemorrhage	42	1%
Other surgical complications	90	3%
Medical complications	**402**	**14%**
DVT / PE*	38	1%
Chest infection	128	4%
Cardiac	120	4%
Other medical complications	208	7%

n = 2,952 treatment episodes

*Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE)

Rectal Cancer

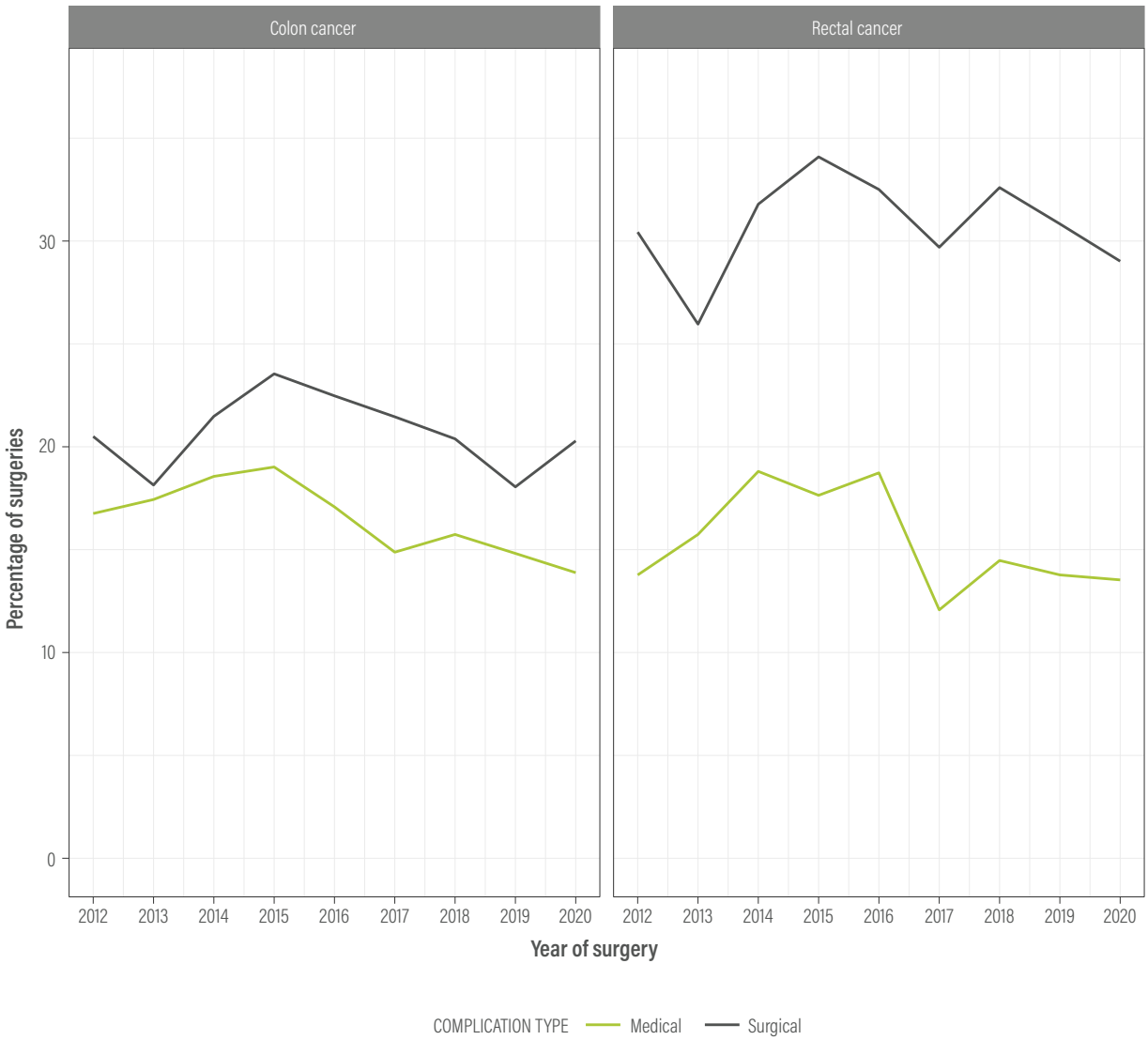
Table 12. Summary of surgical and medical complications of rectal cancer patients who received surgical treatment in 2020

Complication	Count	Percentage
Surgical complications	**332**	**28%**
Prolonged ileus	133	11%
Abdominal/pelvic collection	65	5%
Urinary retention	37	3%
Wound infection	48	4%
Anastomotic leak	35	3%
Superficial wound dehiscence	35	3%
Sepsis	26	2%
Small bowel obstruction	23	2%
Postoperative haemorrhage	18	2%
Deep wound dehiscence	10	1%
Ureteric injury	5	<1%
Other surgical complications	73	6%
Enterocutaneous fistula	2	<1%
Medical complications	**156**	**13%**
Cardiac	36	3%
Chest infection	31	3%
DVT / PE*	16	1%
Other medical complications	101	9%

n = 1,184 treatment episodes

*Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE)

Figure 17. Complications over time in colorectal cancer patients who received surgical treatment



6. CLINICAL QUALITY INDICATORS

Indicators for performance and outcome measurement allow the quality of care and services to be measured. Quality indicators describe the performance that should occur (based on evidence-based standards of care), and then evaluate whether patients' care is consistent with this[16]. The clinical indicators used in the BCCA are process and outcome measures, and are generally rate or mean based, providing a quantitative basis for quality improvement. In most cases, clinical measures must be adjusted for factors outside the health system when benchmarking care, such as patient and disease-related factors.

The BCCA has reported against a number of clinical quality indicators (or KPIs) since 2017. These include:

Primary KPIs:
- Inpatient mortality
- Return to theatre
- Anastomotic leak rate
- Number of lymph nodes examined (colon)
- Circumferential margins (rectal)

Secondary KPIs:
- Adjuvant chemotherapy
- Length of stay
- Surgical complication rate (complications analysed include; Abdominal pelvic collection, Anastomotic leak, Enterocutaneous fistula, Superficial wound dehiscence, Deep wound dehiscence, Wound infection, Temperature > 38.5 ° C with haemodynamic features of sepsis, Prolonged ileus, Small bowel obstruction, Urinary retention, Ureteric injury, Splenectomy, Postoperative haemorrhage, Other)
- Discussed at Multidisciplinary Team Meeting (MDT) (rectal)
- MRI staging (rectal)
- Permanent stoma rate

These KPIs are reported in this chapter and chapters 4 and 5. Health service performance in relation to these are reported to individually participating sites where a sufficient volume of patients is managed. As a compromise between having contemporaneous data and having sufficient site caseload with which to benchmark sometimes rare events, for Annual Reports since 2018, BCCA KPIs comprise the most recent 3 years of data only (unless otherwise indicated). Prior to 2018, these KPIs included cumulative data from 2007, but as the annual number of episodes has increased in recent years, the registry is now able to meaningfully compare data over a rolling 3-year period.

KPIs in this chapter are primarily presented as funnel plots, which are a snapshot at a point in time of comparative performance of centres in relation to an individual measure. The outer lines of the funnel plot provide the statistical limits that define whether the performance of a centre is a statistical outlier or not, with greater uncertainty available to smaller numbers of episodes per centre. Additionally, this variation in site performance is relative to the performance of the sites within the data set and is not measured against an independently agreed target.

Data completeness in registries typically varies for many data items that comprise the clinical indicators, and the items that have been used for risk adjustment. This is because sites enter their own data and factors that affect data entry, such as availability of staff will affect the validity of the data. Also, while most funnel plots have had risk-adjustment models developed, where this is not the case, the limitation of this lack of risk adjustment should be considered in their interpretation.

It is important to note that the BCCA dataset is only representative of those who participate in BCCA; outliers may be identified who may be within the common bounds if all colorectal cancer operations in Australia and New Zealand were entered into BCCA. Data and initial reports must be interpreted with this in mind.

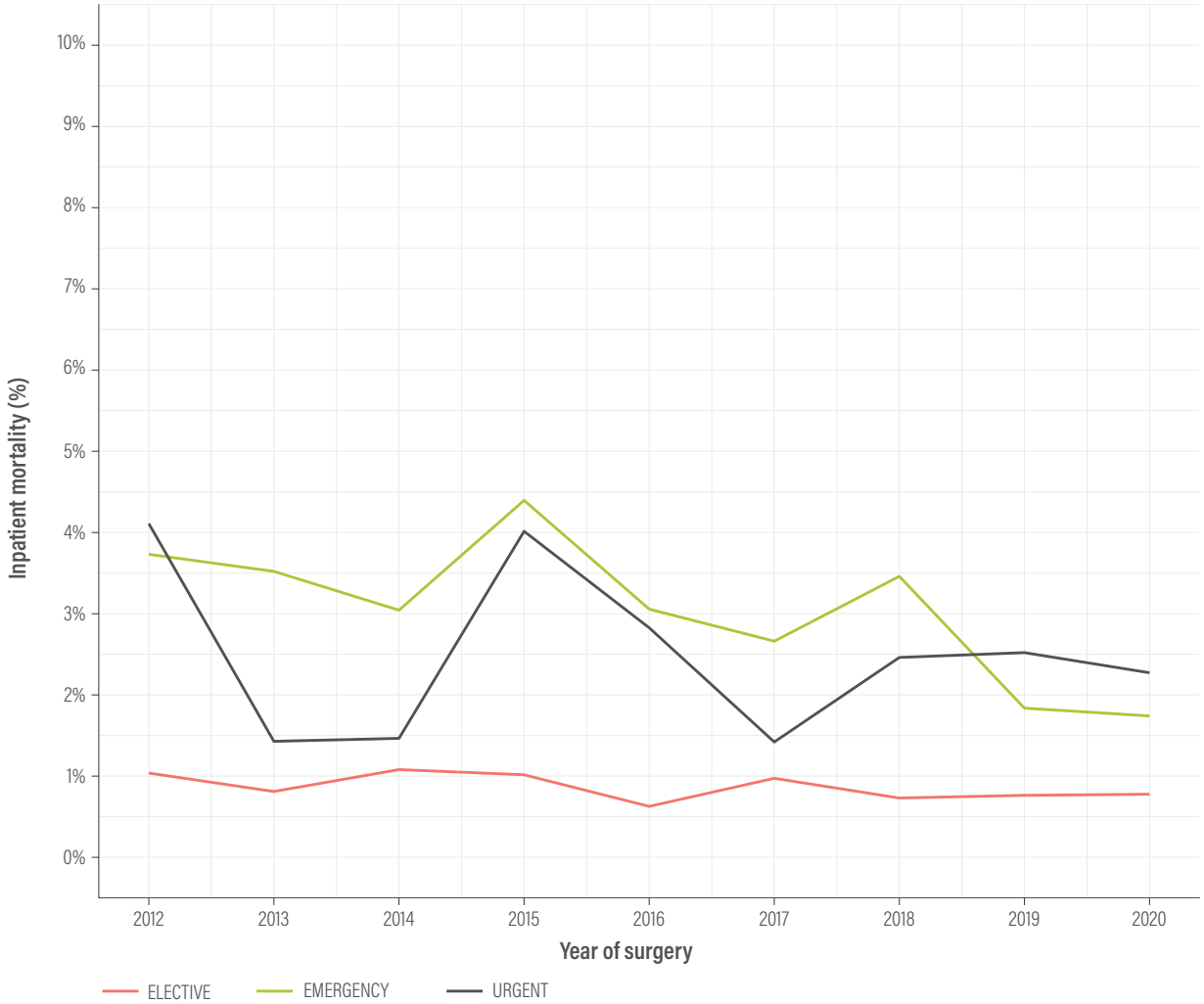
Inpatient mortality

Inpatient mortality remains consistently low at 1% of reported cases (Table 13). Urgency of admission is a factor in hospital mortality. Higher mortality is seen in urgent or emergency cases (Figure 18). In the 2018 to 2020 cohort, the volume of surgery performed by a hospital is associated with reduced inpatient mortality (Figure 19). When adjusted for ASA score, patient age, operative urgency, sex and overall stage, three of the four sites were above the 99.8% control limit and were low volume sites.

Table 13. Hospital mortality in colorectal cancer patients who received surgical treatment, by year of surgery (unadjusted)

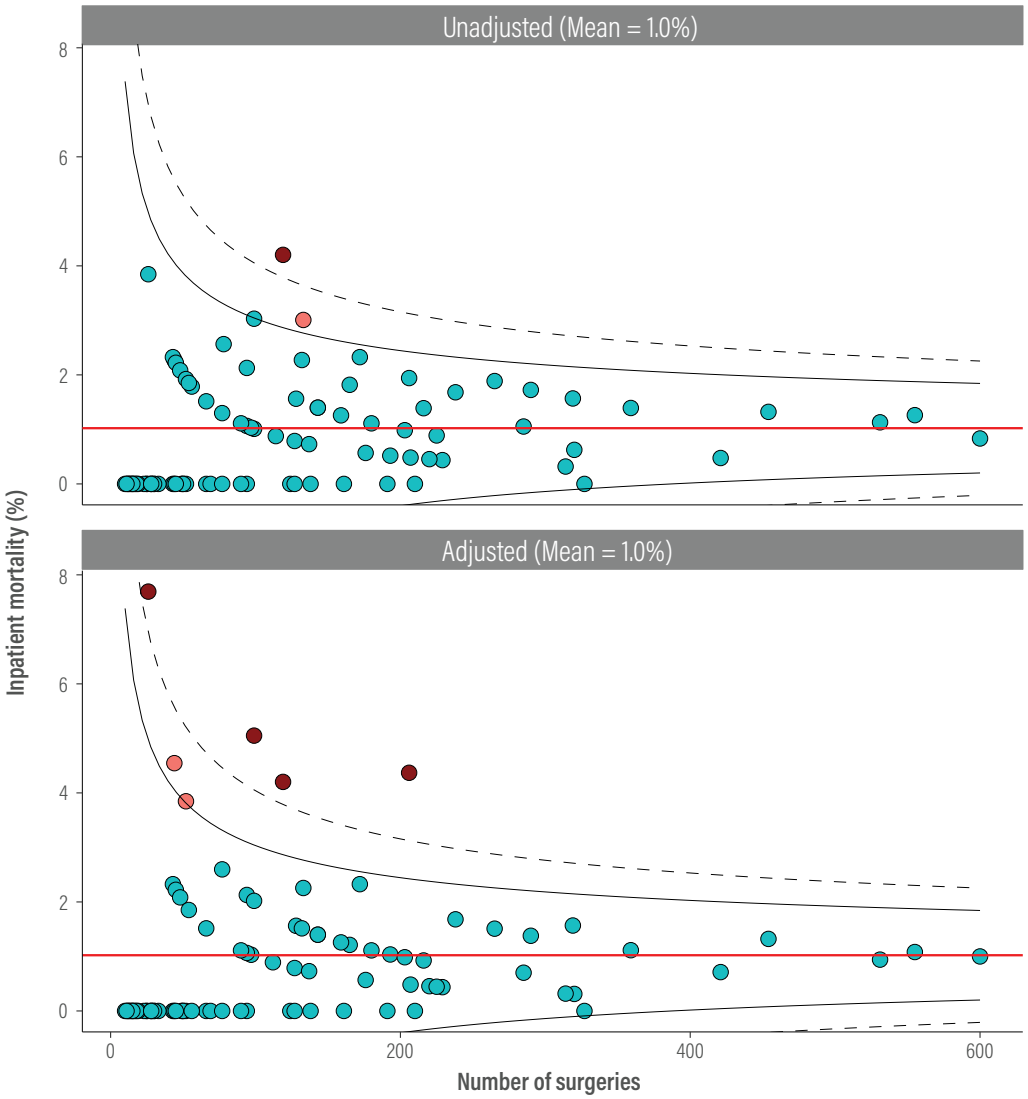
	Treatment Episode	Inpatient death	Inpatient mortality rate (%)
2007	570	11	2
2008	1,237	16	1
2009	1,484	19	1
2010	2,,122	26	1
2011	2,515	48	2
2012	2,352	33	1
2013	2,306	24	1
2014	3,239	42	1
2015	3,566	54	2
2016	3,593	35	1
2017	3,836	43	1
2018	4,335	46	1
2019	4,685	47	1
2020	4,195	42	1
Total	40,035	486	1

Figure 18. Mortality rate over time of colorectal cancer patients who received surgical treatment, by hospital admission category



Elective N = 34,007, Emergency N = 2,790, Urgent N = 2,983, Total N = 39,780

Figure 19. Mortality rate in colorectal cancer patients who received surgical treatment between 2018 and 2020, by site

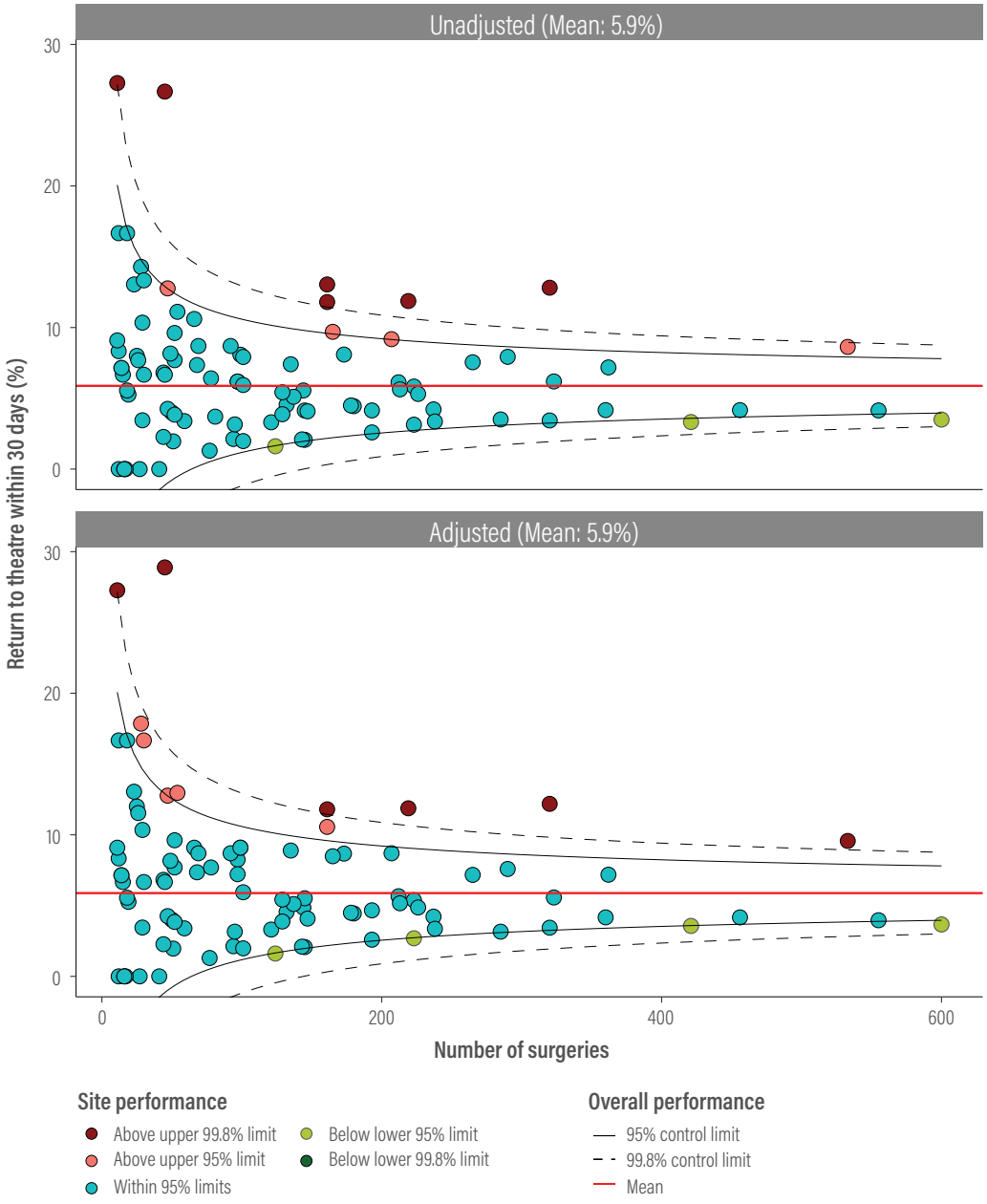


Adjusted for ASA score, patient age at diagnosis, operative urgency, sex and overall stage.
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Return to theatre

Return to theatre within 30 days is an outcome measure that reflects the incidence of serious post- surgical complications. The mean adjusted rate was 5.9% which is stable compared to previous years (Figure 20). The commonest cause for return to theatre was anastomotic leak.

Figure 20. Return to theatre rate in colorectal cancer patients who received surgical treatment between 2018 and 2020, by site



Adjusted for ASA score, cancer type, patient age at diagnosis and operative urgency.
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Surgical complications

Around 1 in 5 patients who underwent a colorectal resection between 2018 and 2020 were identified as having a complication. Funnel plots over the period 2018-2020 are shown below for colon (Figure 21) and rectal surgery (Figure 22) and then risk adjusted rates of overall complications (Figure 23). Caution should be applied in interpreting the relevance of the outliers in these plots as the data is self-reported and not externally validated.

Figure 21. Surgical complication rate in colon cancer patients who received surgical treatment between 2018 and 2020, by site

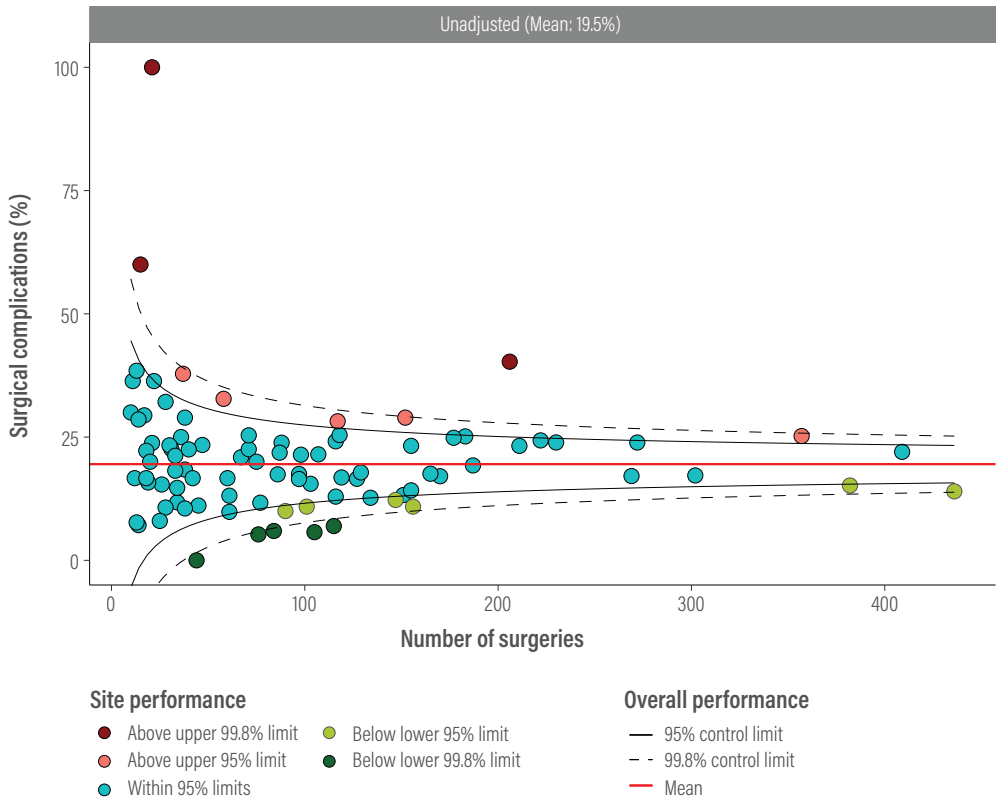


Figure 22. Surgical complication rate in rectal cancer patients who received surgical treatment between 2018 and 2020, by site

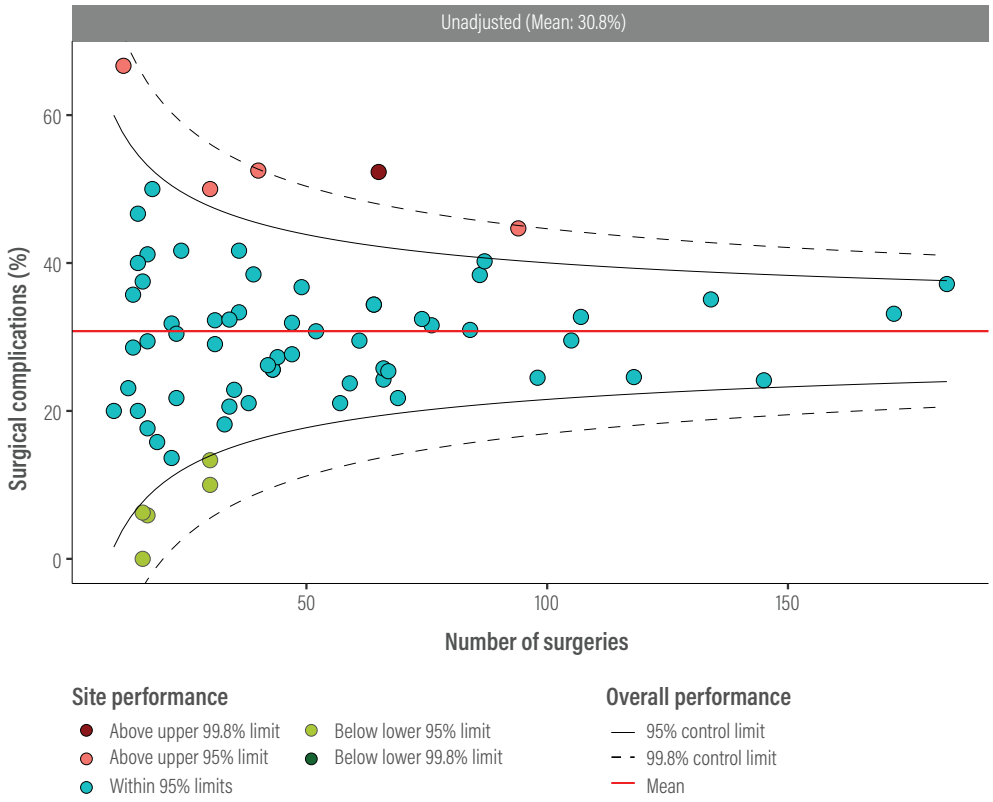
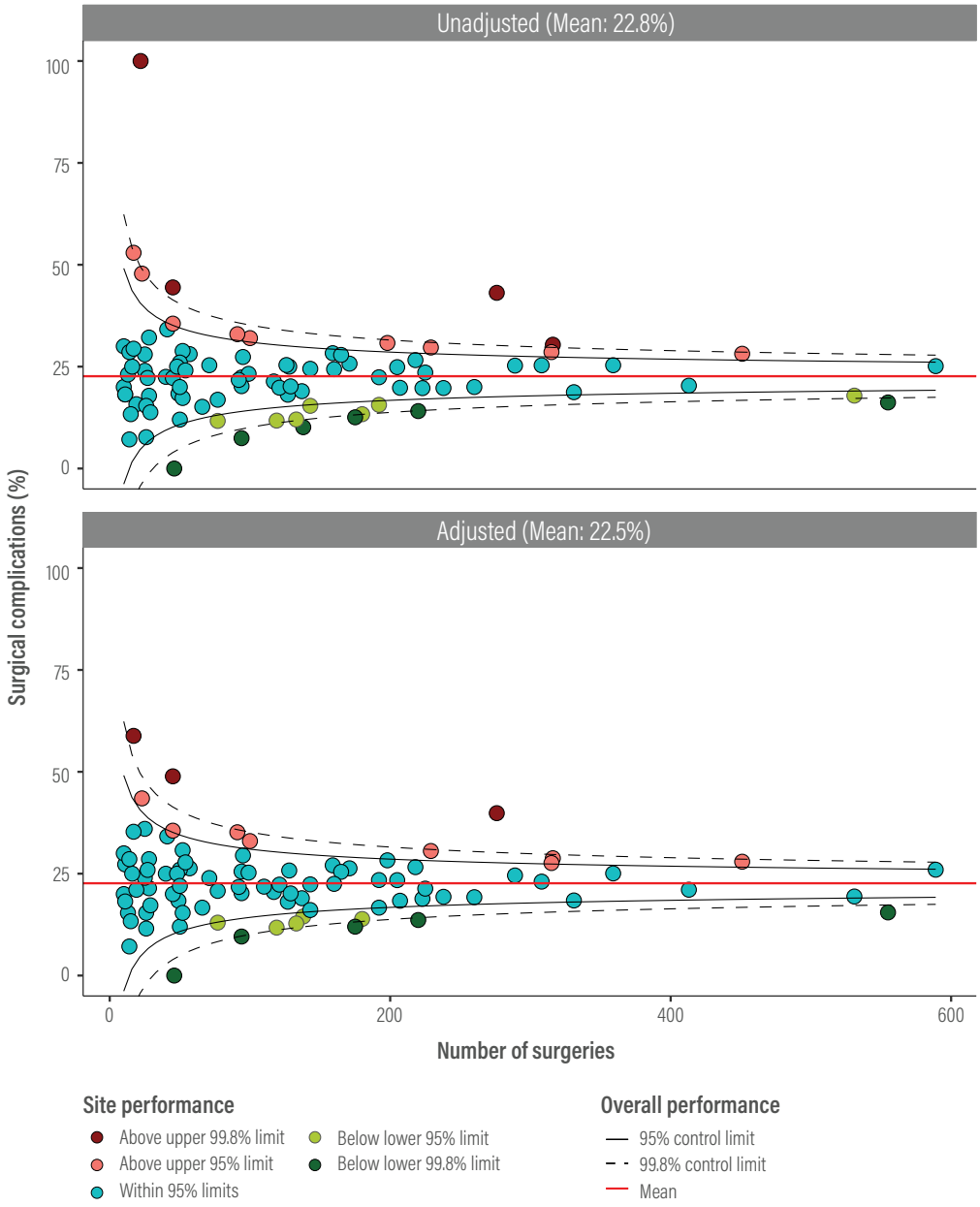


Figure 23. Surgical complication rate in colorectal cancer patients who received surgical treatment between 2018 and 2020, by site

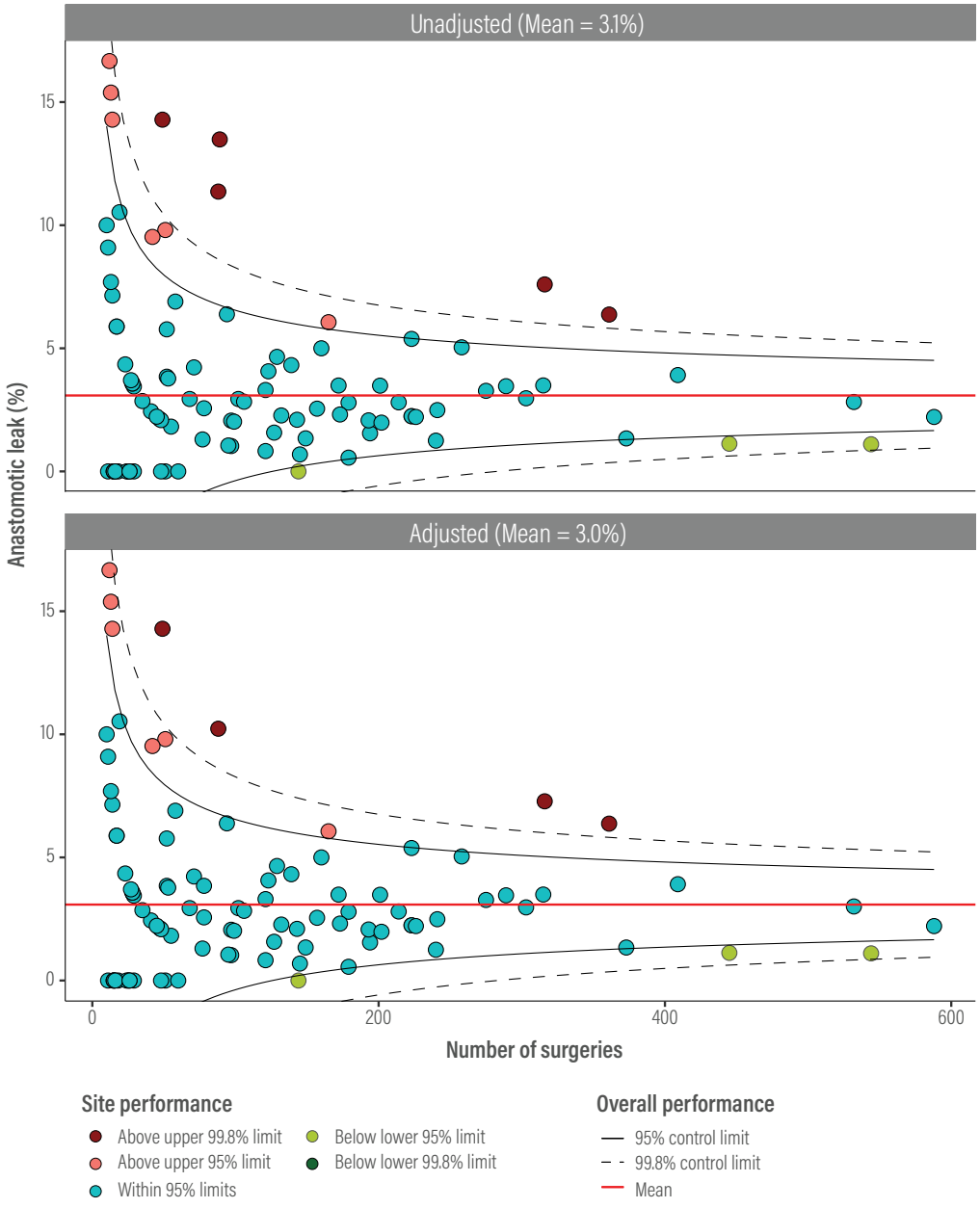


Adjusted for cancer type, ASA score, sex, operative urgency, patient age at diagnosis, and overall stage.
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Anastomotic leak

The rate of anastomotic leak remains low compared to international data with an adjusted mean of 3.0% (Figure 24). Risk adjustments were made for cancer type and age. Multiple factors may account for potential under-reporting for this event e.g delayed diagnosis of leak on subsequent contrast enema study, 'micro-leaks' treated as abdominal collections and reporting bias.

Figure 24. Anastomotic leak rate in colorectal cancer patients who received surgical treatment between 2018 and 2020, by site



Adjusted for sex and cancer type.
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Length of stay

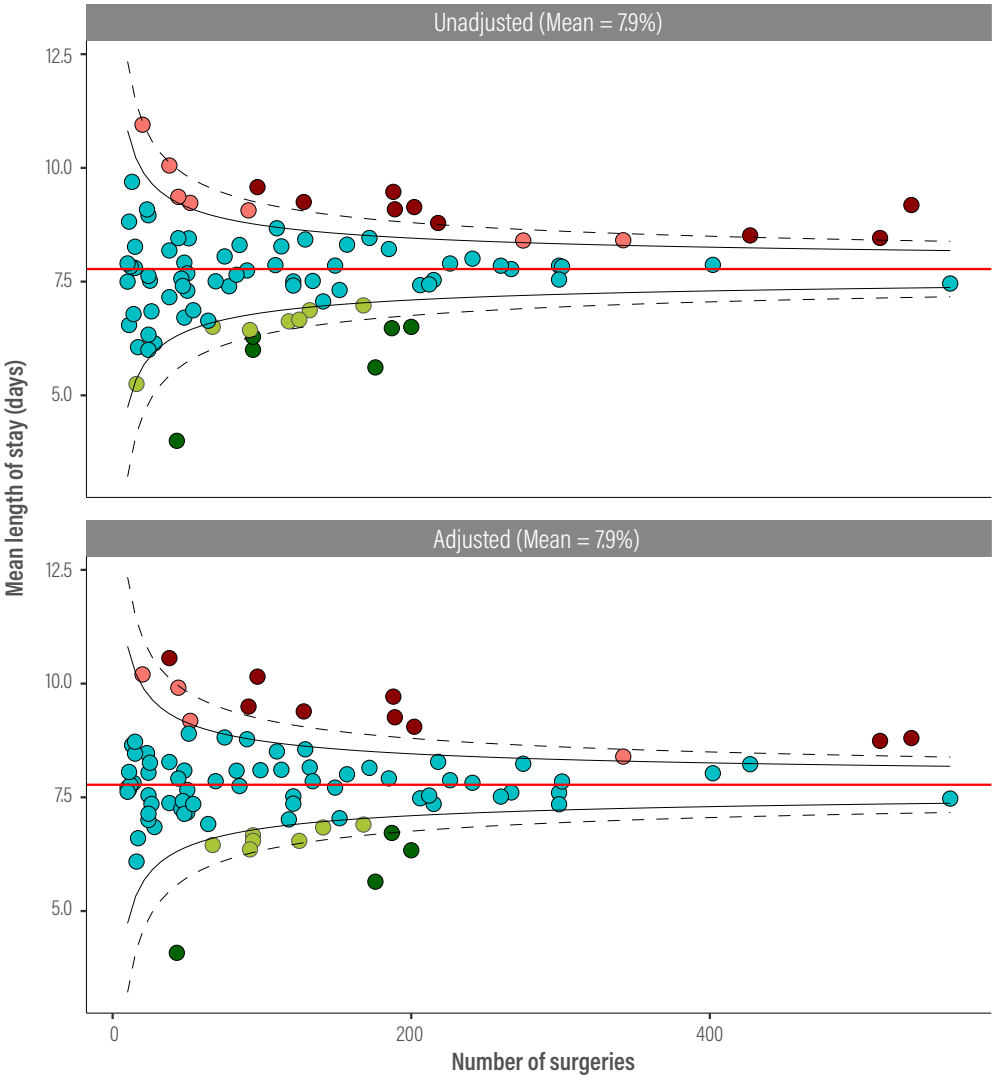
Since the last BCCA reporting period, the overall adjusted mean Length of stay (LOS) has remained consistent at 7.9 days (Figure 25). The mean LOS of patients undergoing colonic surgery was 7.6 days and rectal surgery was 9.4 days.

Urgency of admission, patient factors, stage of disease are factors that can contribute to LOS. When adjusted for these covariates, regardless of case volume, most units have similar LOS likely due to comparable enhanced recovery programs.

LOS above the 95% control limit could be due to factors not adjusted for by the BCCA, such as case complexity and patient discharge logistics (eg. 'out of area' patients or patients with higher needs requiring increased social support organisation prior to discharge).

There were eight reporting sites that were excluded from the final analysis due to incomplete data to adjust for covariates.

Figure 25. Mean length of post-surgical hospital stay in colorectal cancer patients who received surgical treatment between 2018 and 2020, by site



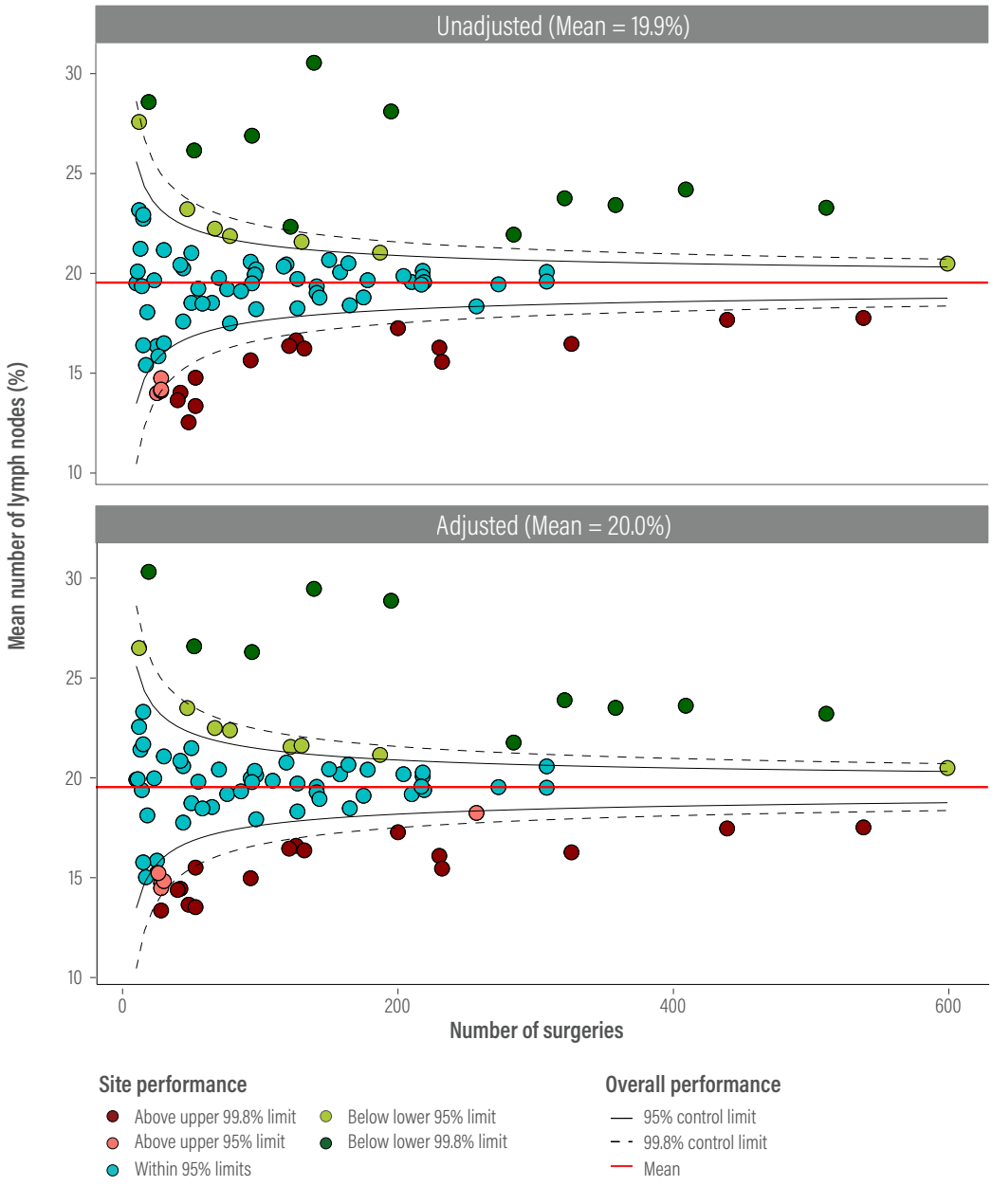
Adjusted for ASA score, cancer type, operative urgency, overall stage, patient age at diagnosis and sex.
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Lymph node examination

Lymph node (LN) status in colorectal cancer is a key factor in determining staging and prognosis. It also guides further interventions, particularly the need for adjuvant therapy and subsequent follow up. Optimal lymph node harvest allows accurate decision making which thereby improves survival. Several variables play a role in LN yield including the quality of surgical resection and pathology assessment, tumour laterality, stage at presentation and the use of neoadjuvant therapy (e.g. rectal cancer). Several international bodies recommend assessment of a minimum of 12 LNs for adequate staging[17-19].

The mean number of nodes per colonic resection in patients who received surgical treatment between 2018-2020 was 19.9 LNs. This did not change significantly (20 LNs) when adjusted (Figure 26). The data is symmetrically distributed with the majority of centres achieving a mean well above the recommended minimum LN harvest. This continues the previously observed trend of excellent lymphadenectomy (2020 BCCA Annual Report) and mirrors findings in other published reports.

Figure 26. Mean number of lymph nodes harvested in colorectal cancer patients who received surgical treatment between 2018 and 2020, by site

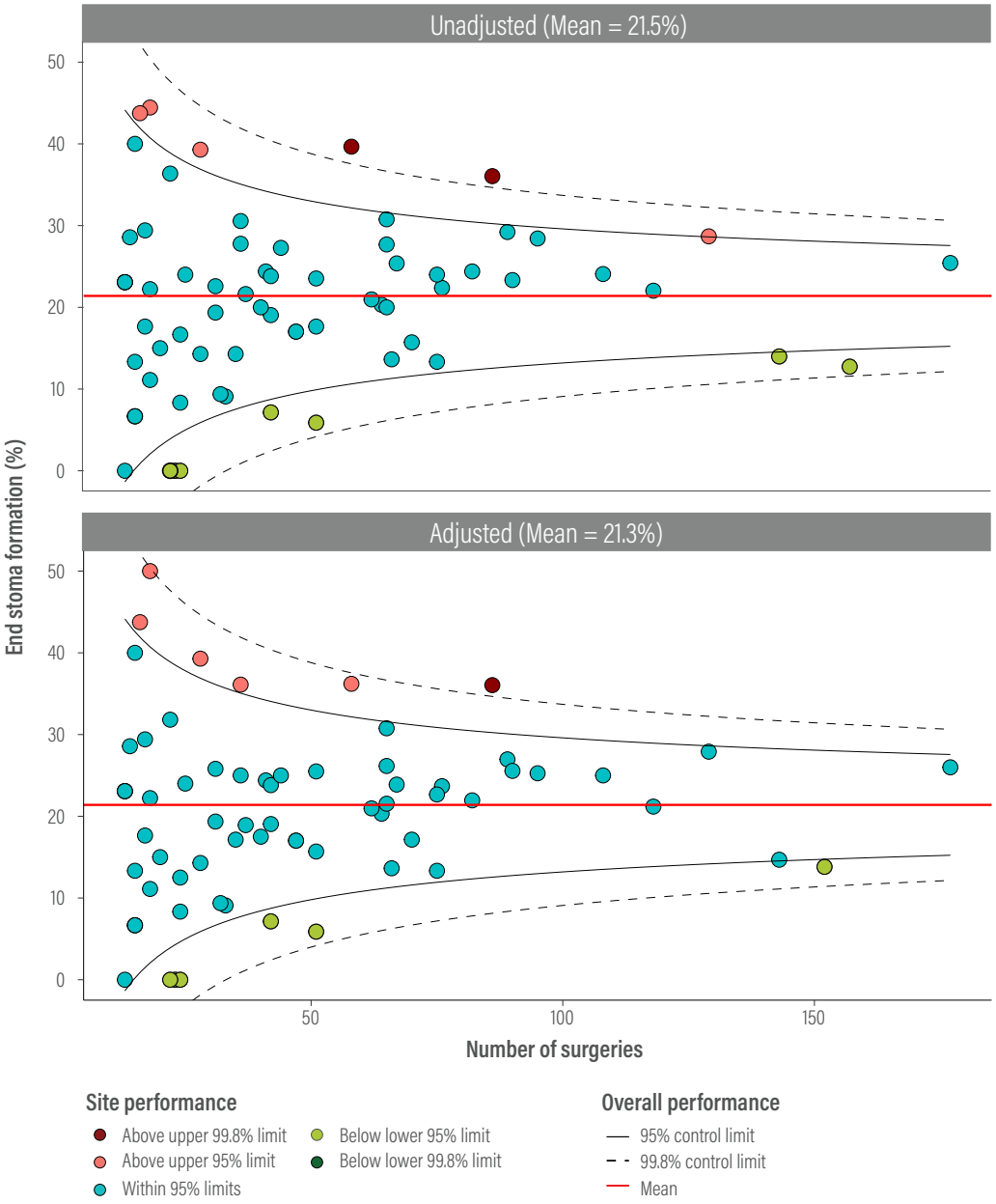


Adjusted for overall stage, patient age at diagnosis, sex, operative urgency and ASA score.
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

End stoma

End stoma rate has been identified as a marker of quality of care in rectal cancer surgery with APR associated with poorer long-term survival, higher local recurrence and CRM positivity[20]. There are a range of surgical techniques, both well established and newer to facilitate anastomosis and minimise the requirement for permanent stoma. In the 2018-2020 cohort the mean end stoma formation rate was 21.5% (Figures 27). Although similar to that previously reported, this rate has trended down over the last 3 years and remains consistent with international data[21, 22].

Figure 27. End stoma rate in rectal cancer patients who received surgical treatment between 2018 and 2020, by site



Adjusted for ASA score, overall stage, and patient age at diagnosis .
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Circumferential margin involvement

A key quality indicator in rectal cancer surgery is the rate that the circumferential resection margin (CRM) is involved (CRM positive) by tumour, suggesting that cancer cells may have been left behind after surgery. Evidence has shown that a CRM that is not clear of tumour significantly increases the risk of local recurrence of cancer. The CRM positivity rate has remained stable at just above 5% for the last decade (Figure 28). There will always be a rate of CRM involvement due to locally advanced tumours at the time of surgery that have already invaded into other tissues. Usually, these have been identified during staging on pelvic MRI, and the patients have been usually referred for preoperative neoadjuvant chemotherapy to attempt to shrink the tumour and reduce the risk of CRM involvement and subsequent local recurrence. CRM is represented as a funnel plot in the BCCA annual report using data over the last 3 years (2018-2020). The average CRM positivity rate was 6.7% (Figure 29). CRM rates have been risk adjusted by controlling for overall stage and operative urgency, as identified by the likelihood ratio test.

The data for 2020 demonstrates an average 4% CRM positive rate in patients who have not received neoadjuvant therapy and 8% CRM positive rate in patients who received neoadjuvant therapy (Table 14). This is likely due to patients selected for neoadjuvant therapy being higher risk with more locally extensive tumours. This compares favourably with other international colorectal cancer registries such as the National Cancer Database (USA) reporting a CRM positive rate of 11.6%[23].

Figure 28. Circumferential margin involvement rate over time in rectal cancer patients who received surgical treatment

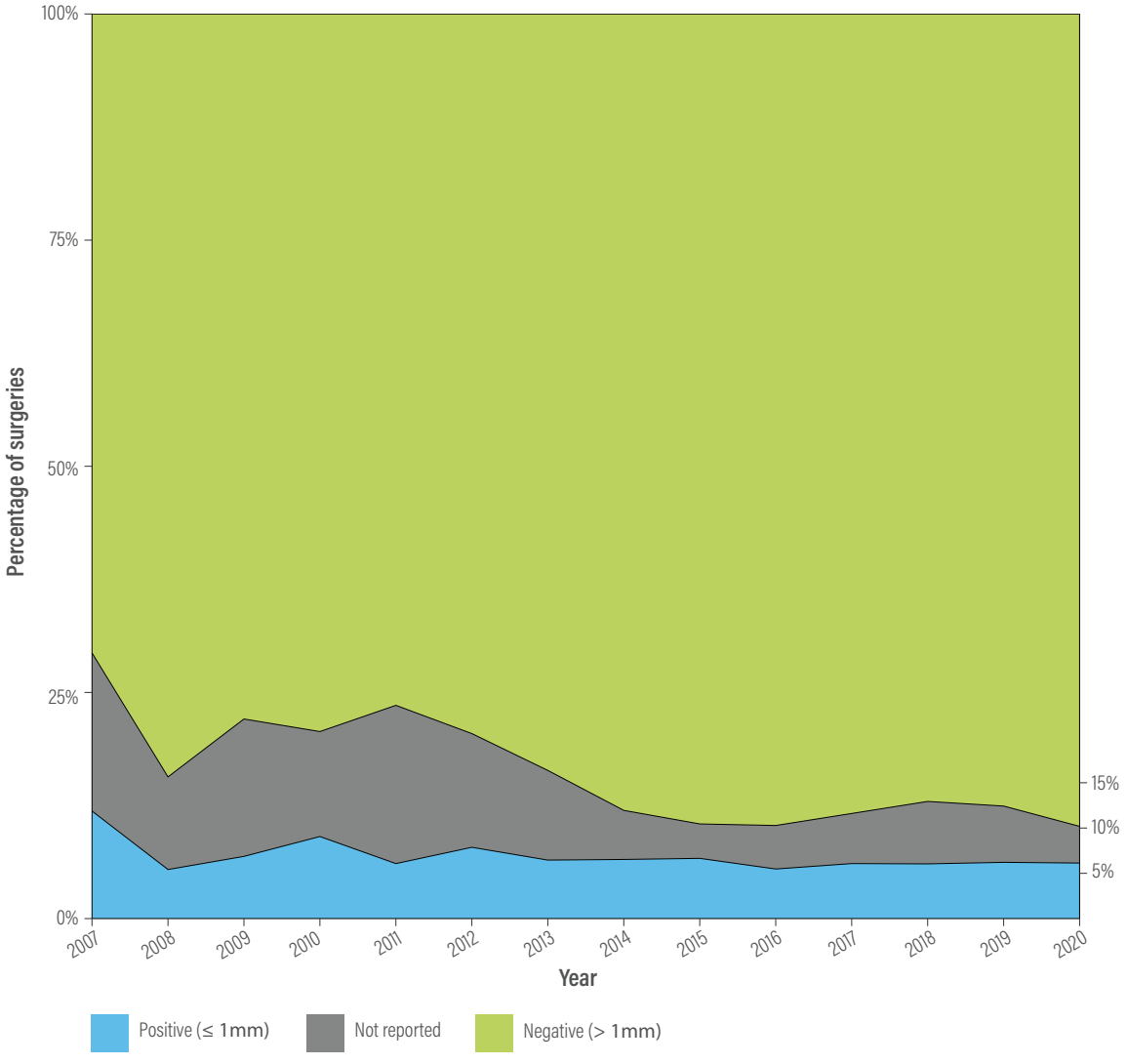
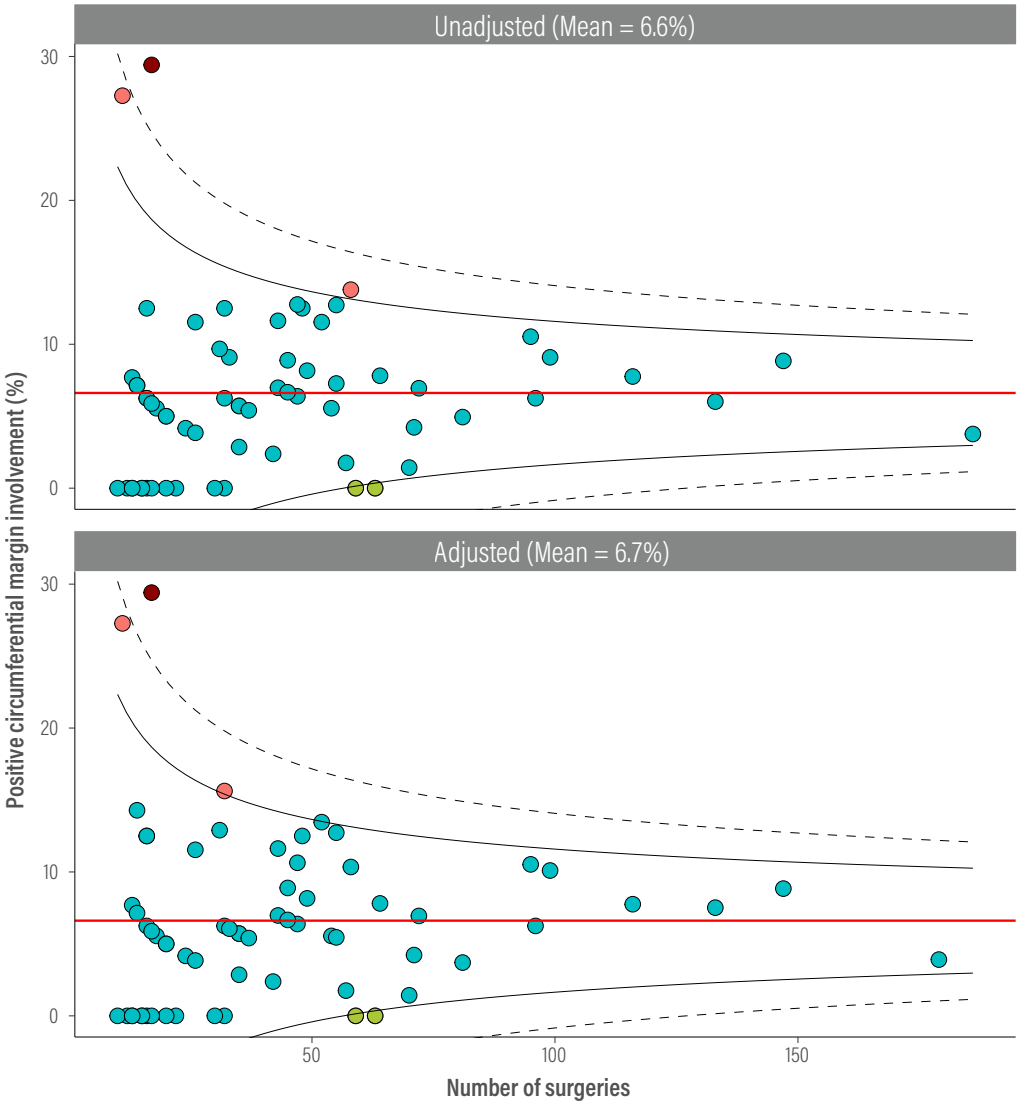


Figure 29. Positive circumferential margin involvement rate in rectal cancer patients who received surgical treatment between 2018 and 2020, by site



Adjusted for overall stage, and operative urgency .
8 sites were excluded due to low completeness of the adjusting covariates and/or outcome.

Table 14. Use of neoadjuvant therapy and circumferential margin involvement in rectal cancer patients who received surgical treatment in 2020

	Neoadjuvant therapy not received		Neoadjuvant therapy received	
	Count	Percentage	Count	Percentage
Negative (> 1mm)	396	90%	497	90%
Not reported	26	6%	15	3%
Positive (<= 1mm)	19	4%	42	8%
Total	441	100%	554	101%

Neoadjuvant therapy received total exceeds 100% due to rounding error

7. RESEARCH, PUBLICATIONS AND PRESENTATIONS (2020)

Published research projects

Publications:

Vather R, Petrushnko W, Chapman D, Sammour T, Mor I, Warner R. (2020). Factors predictive of an advanced stage of colorectal cancer at presentation - a bi-national study. Colorectal Dis, 22(11):1538-44. DOI: **10.1111/codi.15137.**

Cooper EA, Buxey KN, Maslen BJ, Muhlmann M. (2020). Retrospective analysis of a Bi-National Colorectal Cancer Audit to characterize stage II colon cancer patients who were offered adjuvant chemotherapy. ANZ J Surg, 90(6):1136-40. DOI: **10.1111/ans.15735.**

Bedrikovetski S, Dudi-Venkata NN, Kroon HM, Moore JW, Hunter RA, Sammour T. (2020). Outcomes of Minimally Invasive Versus Open Proctectomy for Rectal Cancer: A Propensity-Matched Analysis of Bi-National Colorectal Cancer Audit Data. Dis Colon Rectum, 63(6):778-87. DOI: **10.1097/DCR.0000000000001654.**

Smith N, Waters PS, Peacock O, Kong JC, Lynch AC, McCormick JJ, et al. (2020). Abdominoperineal excision in Australasia: clinical outcomes, predictive factors and recent trends of nonrestorative rectal cancer surgery. Colorectal Dis, 22(11):1614-25. DOI: **10.1111/codi.15263.**

Ng CW, Prabhakaran S, Chakraborty J, Lutton N, Gourlas P, Gillespie C, et al. (2020). Rate of anastomotic leak following right hemicolectomy by general surgical trainees. Int J Colorectal Dis, 35(12):2339-46. DOI: **10.1007/s00384-020-03730-8.**

Kong JC, Su WK, Ng CW, Guerra GR, Chakraborty J, Lutton N, et al. (2021). Colorectal cancer in younger adults from a Bi-National Colorectal Cancer Audit registry. ANZ J Surg, 91(3):367-74. DOI: **10.1111/ans.16250.**

van Harten MJ, Greenwood EB, Bedrikovetski S, Dudi-Venkata NN, Hunter RA, Kroon HM, et al. (2020). Minimally invasive surgery in elderly patients with rectal cancer: An analysis of the Bi-National Colorectal Cancer Audit (BCCA). Eur J Surg Oncol, 46(9):1649-55. DOI: **10.1016/j.ejso.2020.03.224.**

Wilkins S, Oliva K, Chowdhury E, Ruggiero B, Bennett A, Andrews EJ, et al. (2020). Australasian ACPGBI risk prediction model for 30-day mortality after colorectal cancer surgery. BJS Open. DOI: **10.1002/bjs5.50356.**

Taylor S, Salimi F, Earnest A, Heriot AG, Zalcberg JR, Ahern S. (2021). The short to medium term benefits of the Australian colorectal cancer screening program. Med J Aust, 214(2):90-2. DOI: **10.5694/mja2.50859.**

Cross AJ, Kornfalt P, Lidin J, Buchwald P, Frizelle FA, Eglinton TW. (2020). Surgical outcomes following colorectal cancer resections in patients aged 80 years and over: results from the Australia and New Zealand Binational Colorectal Cancer Audit. Colorectal Dis. DOI: **10.1111/codi.15445.**

Grupa VEM, Kroon HM, Ozmen I, Bedrikovetski S, Dudi-Venkata NN, Hunter RA, et al. (2021). Current practice in Australia and New Zealand for defunctioning ileostomy after rectal cancer surgery with anastomosis: Analysis of the Binational Colorectal Cancer Audit. Colorectal Dis. DOI: **10.1111/codi.15607.**

Presentations:

Cheong J, Byrne C, Young C. (ASCRS Annual Scientific Meeting 2021, April). The effect of BMI on the LN harvest yield in the four different colorectal cancer resection approaches: review of bcca database. Dis Colon Rectum, 64 (5); POD102, 147.

Cooper E, Buxey K, Muhlmann M. (RACS, ASC 2020, June). Retrospective analysis of a bi-national colorectal cancer audit to characterize stage II colon cancer patients that were offered adjuvant chemotherapy. ANZ J Surg, 90 (S1): CR447, 30.

Grupa V, Kroon H, Ozmen I, Bedrikovetski S, Dudi-Venkata N, Hunter A, Sammour T. (RACS, ASC 2020, June). Current practice in Australia and New Zealand of covering low anastomoses with a loop ileostomy after rectal cancer surgery: analysis of the Binational Colorectal Cancer Audit (BCCA). ANZ J Surg, 90 (S1): CR490P, 41.

Kroon H, Van Harten M, Greenwood E, Bedrikovetski S, Dudi-Venkata N, Hunter R, Sammour T. (RACS, ASC 2020, June). Minimally invasive surgery in elderly patients with rectal cancer is safe: an analysis of the Binational Colorectal Cancer Audit (BCCA). ANZ J Surg, 90 (S1): CR516P, 47.

Tiang, T., Proud, D. (ASCRS Annual Scientific Meeting 2021, April). Does Complete Pathological Response Increase Perioperative Morbidity Risk in Patients Undergoing Resection for Rectal Cancer Following Neoadjuvant Treatment?. Dis Colon Rectum, 64 (5); POD320, 120.

Currently Approved Projects

1. Assessment of morbidity in patients with complete pathological response to neoadjuvant therapy for rectal cancer.

Investigator: Mr David Proud, Austin Health.

Status: Accepted for a Presentation on Demand, ASCRS Annual Scientific Meeting 2021, San Diego, CA.

The objective of this project is to determine if there is an increased risk of surgical morbidity in patients with complete pathological response following neoadjuvant therapy for rectal cancer in the BCCA database.

2. Trends and outcomes in neoadjuvant chemotherapy and radiotherapy for rectal cancer.

Investigator: Mr Raymond Yap, Cabrini Institute.

Status: Approved.

The objective of this project is to discuss and analyse the trends in neoadjuvant therapy for rectal cancer in relation to changes in guidelines and their impact on surgical outcomes.

3. Robotic vs laparoscopic right hemicolectomy: an examination of the Binational Colorectal Cancer Database.

Investigators: Dr Philip Smart, Mr Satish Warrier, Epworth Healthcare.

Status: Complete.

Publication: Submitted for publication.

The objective of this project is to compare clinical outcomes in patients undergoing laparoscopic colectomy with and without the use of robotic assistance.

4. Right hemicolectomy anastomotic leak rate study (RALS).

Investigator: Associate Professor Matthew Rickard, Concord Hospital Clinical School.

Status: Approved.

The objective of this project is to investigate anastomotic leak rates following stapled versus handsewn ileo-colic anastomoses in Australasian patients in the Binational Colorectal Cancer Audit.

5. Regional variance in treatment and outcomes for rectal cancer surgery in Australia and New Zealand: Analysis of the Bi-National Colorectal Cancer Audit (BCCA).

Investigator: Associate Professor Tarik Sammour, Royal Adelaide Hospital.

Status: Approved.

The objective of this project is to identify regional variances in treatment and outcomes following rectal cancer surgery in ANZ by analyzing the data as registered in the BCCA.

6. Patterns of recurrence after an anastomotic leak for colorectal Cancer.

Investigator: Mr Joseph Kong, Professor Alexander Heriot, Peter MacCallum Cancer Centre.

Status: Approved.

The objective of this project is to interroge the patterns of recurrence after an anastomotic leak from colorectal cancer resection and the overall survival in Australia and New Zealand.

7. Clinical predictors of rectal cancer response after neoadjuvant (chemo) radiotherapy in Australasia: An analysis of the Bi-National Colorectal Cancer Audit (BCCA).

Investigator: Mr James Moore, Dr Hidde Kroon, Royal Adelaide Hospital.

Status: Approved.

The objective of this project is to identify clinical patient and tumour factors to predict pathological response to neo-adjuvant (chemo)radiotherapy in rectal cancer patients treated in Australia and New Zealand by analysing the data as registered in the Bi-National Colorectal Cancer Audit.

8. Effect of the Coronavirus/ COVID-19 pandemic on colorectal cancer diagnosis and management.

Investigator: Mr Stephen Bell, Evan Williams, Alfred Health.

Status: Approved.

The objective of this project is to analyse patients entered into the Bi-National Colorectal Cancer Audit (BCCA) and compare groups before, during and in the aftermath of the Coronavirus/COVID-19 pandemic.

9. Multi-disciplinary care for colorectal cancer - analysis of a Bi-National Colorectal Cancer Database.

Investigator: Dr Mark Cooper, Dr Mark Muhlmann Prince of Wales Hospital.

Status: Approved.

The objective of this project is to analyse and characterise which patients with colorectal cancer in Australia and New Zealand are being discussed in an MDT and which patients are not.

10. International evaluation of differences in case-mix models used in three national colorectal cancer audits

Investigator: Dr Michelle Thomas, Royal Adelaide Hospital.

Status: Approved.

The objective of this project is to evaluate the data entered in three national colorectal cancer audits on different possibilities of case-mix correction and to evaluate the differences in design of these audits.

11. Locally advanced and recurrent colonic cancer - outcomes and oncological survival.

Investigator: Mr Satish Warrier, Peter MacCallum Cancer Centre.

Status: Approved.

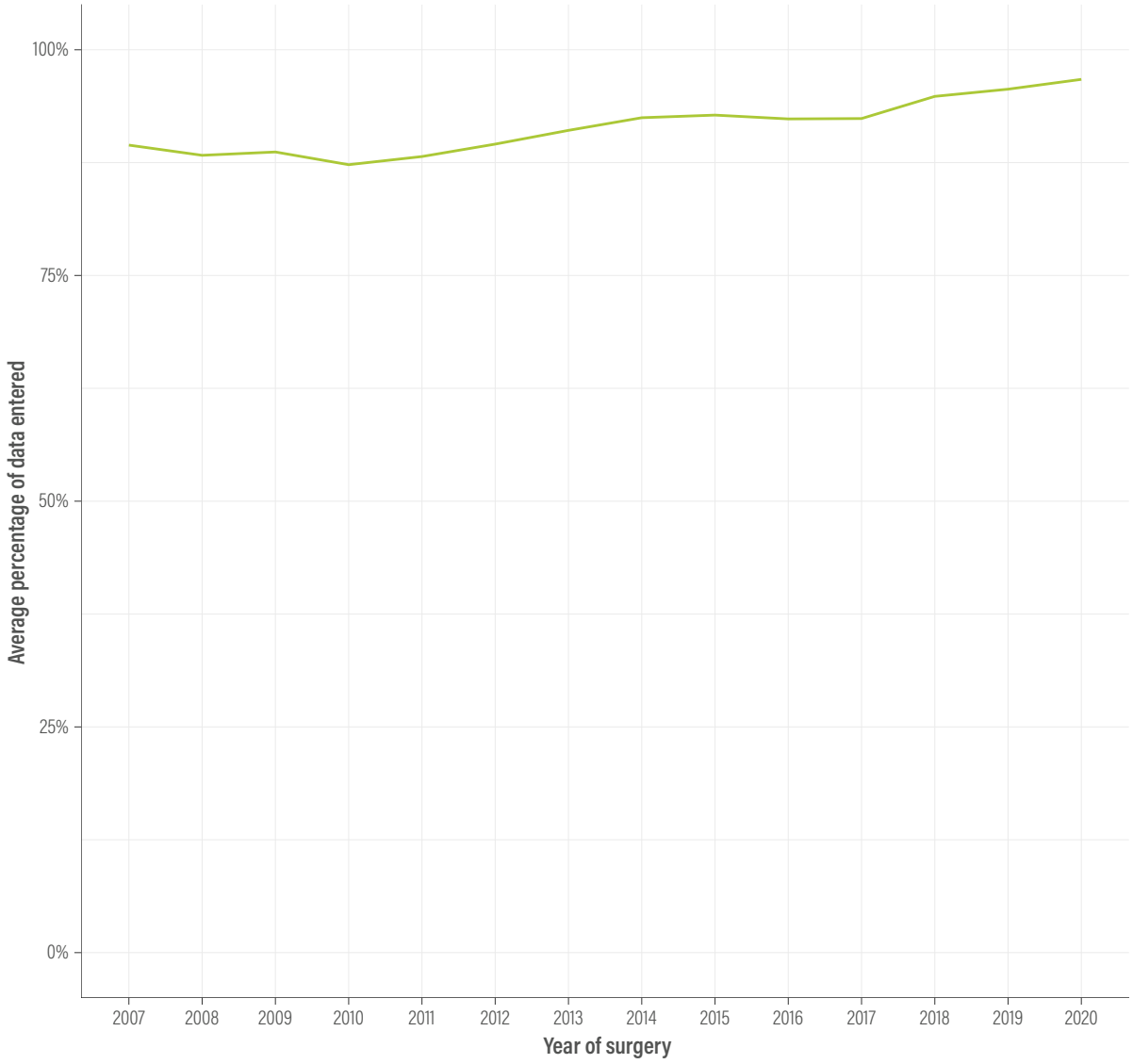
The objective of this project is to assess the long term oncological and pathological outcomes for patients with non metastatic locally advanced colon cancer, and use of neoadjuvant therapies; and to determine rates of R0 resection.

For further information about these projects please contact the investigators. A complete list of approved, published or presented projects can be found at **bowelcanceraudit.com**

8. QUALITY ASSURANCE

Data completion

Figure 30. Mean percentage of data completion over time across 29 key BCCA items



BCCA is analysed for data completeness based on 29 elements (Patient ID, date of birth, hospital code, consultant code, tumour diagnosis screening FOBT, rectal cancer, discussed at MDT, surgery planned, surgery date, operative urgency, ASA score, surgical entry, tumour site, procedure type, stoma formed, discharge date, surgical complications, medical complications, returned to theatre, inpatient death, 30 day mortality, primary tumour stage, regional lymph nodes stage and Distant metastasis stage, lymph nodes harvested, adjuvant therapy, circumferential margins, and neoadjuvant therapy) (Figure 30).

9. FUTURE DIRECTIONS

BCCA needs funding to realise the benefit it is capable of delivering. Bowel cancer is the number six cause of death for Australians but is also biologically favorable with an opportune pre-clinical phase and an effective, established screening program. This screening program is taken up by only 42% of patients offered. We can do better and data is the key.

There remains an immense, cost effective means to save lives and reduce human suffering by accurate reporting, examination and systematic improvement of bowel cancer care across Australia and New Zealand.

BCCA is committed to this cause.

In 2020 BCCA increased case capture, expanded research output, planned a new database, thought about how to systematically listen to patients (PROMs) and met with many stakeholders and potential funding sources. BCCA worked to deliver value to clinicians, including the development of clinical dashboards. BCCA have invited non surgical clinicians to join the registry and explored opportunities with our valued Monash partner, who have deep expertise in clinical outcomes registries.

In 2020 we established a newsletter, expanded social media, invited a patient to our Operations Committee and also included two CSSANZ Fellows.

BCCA published eleven high quality research papers and established the groundwork for many more.

In 2021 the focus is rebuilding the database to provide value to contributing members, as well as seeking ongoing development funding.

BCCA is looking forward to a productive year ahead.

APPENDIX A – Registry Personnel 2020

BCCA Steering Committee membership

Mr Andrew Hunter (Chair)

Dr Philip Smart (Chair BCCA Operations Committee)

Mr Ian Faragher (Colon and Rectal Surgery Section, RACS)

Mr Andrew Hughes (GSA)

Professor John Zalcberg (Interested Clinician)

Mr John Stubbs (Consumer Representative)

Rowan Collinson (CSSANZ) since November 2020

Mr Grant Coulter (NZAGS) until September 2020

Dr Damien Peterson (CSSANZ) until November 2020

The BCCA Steering Committee membership is made up of the Chair, one member of the CSSANZ Council, one member of RACS Colon and Rectal Surgery Section Executive, one representative recommended by GSA Council, one representative recommended NZAGS, a clinician with an interest in colorectal cancer, one consumer representative and the Chair of the BCCA Operations Committee.

BCCA Operations Committee Membership

Dr Philip Smart (Victoria)(Chair)

Professor Alexander Heriot (Victoria)

Ms Angela Brennan (DEPM)

Professor Susannah Ahern (DEPM)

Professor Paul McMurrick (Victoria) (CRC Audit)

Associate Professor Chris Byrne (New South Wales)

Dr Elizabeth Murphy (South Australia)

Associate Professor Mark Thompson-Fawcett (New Zealand)

Dr Sze-Lin Peng (New Zealand)

Dr Anthony Ciccocioppo (South Australia)

Dr Greg Nolan (Queensland)

Dr Aymen Al-Timimi (Queensland)

Associate Professor Tarik Sammour (South Australia) since April 2020

Dr Farhad Salimi (DEPM) since June 2020

Dr Raymond Yap (Victoria) since December 2020

Professor Christopher Reid (DEPM) until July 2020

Professor Cameron Platell (Western Australia) until September 2020

Mr John Lengyel (New Zealand) until September 2020

Dr Ryash Vather (Fellow representative) June 2020 to December 2020

The BCCA Operations Committee membership is made up of the Chair, Representatives of the Department of Epidemiology & Preventive Medicine, Monash University (DEPM), a representative of CRC Audit (the extended dataset), representatives of ANZTBCRS Training Fellows, surgeons who regularly undertake surgery for colorectal cancer providing a broad geographic binational representation and other co-opted members as required.

BCCA Research Committee membership

Professor Alexander Heriot (Chair)

Associate Professor Tarik Sammour

Ms Angela Brennan (DEPM)

Dr Farhad Salimi (DEPM)

Dr Ryash Vather (Fellow representative) until December 2020

The BCCA Research Committee membership is made up of the Chair, Representatives of the Department of Epidemiology & Preventive Medicine, Monash University (DEPM), and representatives of ANZTBCRS Training Fellows and other co-opted members as required.

APPENDIX B – Glossary

AJCC	– American Joint Committee on Cancer
APR	– Abdominoperineal Resection
ASA	– American Society of Anaesthesiologists Classification
ASC	– Annual Scientific Congress
ASCRS	– The American Society of Colon and Rectal Surgeons
BCCA	– Binational Colorectal Cancer Audit
CME	– Continuing Medical Education
CRM	– Circumferential Resection Margin
CRC Audit	– Colorectal Cancer Audit (Extended dataset managed by Professor Paul McMurrick via Cabrini Institute)
CSSANZ	– Colorectal Surgical Society of Australia and New Zealand
DEPM	– Department of Epidemiology and Preventative Medicine, Monash University
DVT	– Deep Vein Thrombosis
FOBT	– Faecal Occult Blood Test
GSA	– General Surgeons Australia
KPIs	– Key Performance Indicators
LN	– Lymph Nodes
LOS	– Length of Stay
MDT	– Multidisciplinary Team Meeting
MIS	– Minimally Invasive Surgery
MRI	– Magnetic Resonance Imaging
NBCSP	– National Bowel Cancer Screening Program
NBSP	– National Bowel Screening Programme
NZAGS	– New Zealand Association of General Surgeons
PE	– Pulmonary Embolism
RACGP	– Royal Australian College of General Practitioners
RACS	– Royal Australasian College of Surgeons
TAMIS	– Transanal Minimally Invasive Surgery
taTME	– Transanal Total Mesorectal Excision
TEMS	– Transanal Endoscopic Microsurgery
TE	– Treatment Episodes
TNM	– Tumour staging system (tumour, node, metastasis)

APPENDIX C – BCCA Participating Hospitals

State	Hospital
ACT	Calvary ACT
ACT	Calvary Bruce Private Hospital
ACT	Canberra Hospital
NSW	Bankstown Hospital
NSW	Blacktown Hospital
NSW	Calvary Riverina
NSW	Chris O'Brien Lifehouse
NSW	Concord Repatriation General Hospital
NSW	Gosford Private Hospital
NSW	Gosford Public Hospital
NSW	Hurstville Private Hospital
NSW	John Hunter Hospital
NSW	Lismore Base Hospital
NSW	Liverpool Hospital
NSW	Macquarie University Hospital
NSW	Maitland Hospital
NSW	Maitland Private Hospital
NSW	Mater Sydney
NSW	Nepean Hospital
NSW	North Shore Specialist Day Hospital
NSW	Northern Beaches Hospital
NSW	Norwest Private Hospital
NSW	Orange Health Service
NSW	Port Macquarie Base Hospital
NSW	Prince of Wales Public Hospital
NSW	Royal North Shore Hospital
NSW	Royal Prince Alfred Hospital
NSW	Ryde Hospital
NSW	St George Hospital
NSW	St George Private Hospital
NSW	St Vincent's Hospital Lismore
NSW	Sydney Adventist Hospital
NSW	The Tweed Hospital
NSW	Wagga Wagga Base Hospital
NSW	Westmead Public Hospital
NSW	North Shore Private Hospital
NT	Royal Darwin Hospital
NZ	Auckland City Hospital
NZ	Christchurch Hospital
NZ	Dunedin Hospital
NZ	Grace Hospital
NZ	Hawkes Bay Regional Hospital
NZ	Mercy Ascot Hospital
NZ	Middlemore Hospital
NZ	North Shore Hospital
NZ	Palmerston North Hospital
NZ	Rotorua Hospital
NZ	Southern Cross North Harbour
NZ	St George's Hospital
NZ	Taranaki Base Hospital
NZ	Tauranga Hospital
NZ	Timaru Hospital
NZ	Whangarei Hospital

State	Hospital
QLD	Allamanda Private Hospital
QLD	Cairns Base Hospital
QLD	Gold Coast University Hospital
QLD	Holy Spirit Northside Private Hospital
QLD	Ipswich Hospital
QLD	John Flynn Private Hospital
QLD	Mater Private Hospital Brisbane
QLD	Noosa Hospital
QLD	Pindara Private Hospital
QLD	Princess Alexandra Hospital
QLD	QEII Jubilee Hospital
QLD	Royal Brisbane and Women's Hospital
QLD	Sunnybank Private Hospital
QLD	Sunshine Coast University Hospital
QLD	The Sunshine Coast Private Hospital
QLD	The Wesley Hospital
SA	Calvary Central Districts Hospital
SA	Calvary North Adelaide
SA	Flinders Medical Centre
SA	Lyell McEwin Hospital
SA	Royal Adelaide Hospital
SA	St Andrew's Hospital
SA	The Queen Elizabeth Hospital
TAS	Calvary Lenah Valley
TAS	Hobart Private Hospital
TAS	Launceston General Hospital
VIC	Alfred Hospital
VIC	Angliss Hospital
VIC	Austin Hospital
VIC	Bairnsdale Regional Health Service
VIC	Ballarat Base Hospital
VIC	Box Hill Hospital
VIC	Cabrini Hospital
VIC	Dandenong Hospital
VIC	Epworth Eastern Hospital
VIC	Epworth Freemasons Hospital
VIC	Epworth Geelong Hospital
VIC	Epworth Richmond Hospital
VIC	Footscray Hospital
VIC	Frankston Hospital
VIC	Maroondah Hospital
VIC	Peter MacCallum Cancer Centre
VIC	St John of God Ballarat Hospital
VIC	St Vincent's Hospital
VIC	Sunshine Hospital
VIC	The Northern Hospital
VIC	The Royal Melbourne Hospital
VIC	Warringal Private Hospital
WA	Fiona Stanley Hospital
WA	Hollywood Private Hospital

APPENDIX D – BCCA Participating Clinicians

Sarah Abbott
Sinan Albayati
Nagham AlMozany
Aymen Al-timimi
Rafid Alzubaidy
Vinna An
Janet Ansell
Asiri Arachchi
Thomas Arthur
Andrew Audeau
Alisha Azmir
Richard Babor
Vikram Balakrishnan
Hasitha Balasuriya
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APPENDIX E – List of Figures

APPENDIX F – List of Tables

APPENDIX G – References

1. Kong JC, Su WK, Ng CW, Guerra GR, Chakraborty J, Lutton N, et al. (2021). Colorectal cancer in younger adults from a Bi-National Colorectal Cancer Audit registry. ANZ J Surg, 91(3):367-74. DOI: **10.1111/ans.16250.**

2. Taylor S, Salimi F, Earnest A, Heriot AG, Zalcberg JR, Ahern S. (2021). The short to medium term benefits of the Australian colorectal cancer screening program. Med J Aust, 214(2):90-2. DOI: **10.5694/mja2.50859.**

3. Australian Bureau of Statistics (2020). Causes of Death 2019. Australia; ABS. Date Accessed April 2021. Available from: <https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/2019>.

4. Ministry of Health (2018). Bowel Cancer. New Zealand Ministry of Health. Date Accessed April 2021. Available from: <https://www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/bowel-cancer>.

5. Feletto E, Yu XQ, Lew JB, St John DJB, Jenkins MA, Macrae FA, et al. (2019). Trends in Colon and Rectal Cancer Incidence in Australia from 1982 to 2014: Analysis of Data on Over 375,000 Cases. Cancer Epidemiol Biomarkers Prev, 28(1):83-90. DOI: **10.1158/1055-9965.EPI-18-0523.**

6. Australian Institute of Health and Welfare (AIHW) (2020). Cancer Data in Australia. Canberra: AIHW. Date Accessed April 2021. Available from: <https://www.aihw.gov.au/reports/cancer/cancer-data-in-australia/>.

7. Ministry of Health (2020). Cancer-historical-summary-1948-2017. New Zealand Ministry of Health. Date. Available from: <https://www.health.govt.nz/publication/cancer-historical-summary-1948-2017>.

8. Ministry of Health (2020). New cancer registrations 2018. New Zealand Ministry of Health. Date Accessed April 2021. Available from: <https://www.health.govt.nz/publication/new-cancer-registrations-2018>.

9. Bartosch J (2021). Why are more people under 50 getting colorectal cancer? The University of Chicago Medicine. Date Accessed April 2021. Available from: <https://www.uchicagomedicine.org/forefront/cancer-articles/why-are-more-people-under-50-getting-colorectal-cancer>.

10. Hendrie D (2020). Evidence suggests it's time to lower the bowel cancer screening age. The Royal Australian College of General Practitioners (RACGP). Date Accessed April 2021. Available from: <https://www1.racgp.org.au/newsgp/clinical/new-evidence-suggests-it-s-time-to-lower-australia>.

11. The American Cancer Society medical and editorial content team (2020). American Cancer Society Guideline for Colorectal Cancer Screening. The American Cancer Society. Date Accessed April 2021. Available from: <https://www.cancer.org/cancer/colon-rectal-cancer/detection-diagnosis-staging/acs-recommendations.html>.

12. Committee on Economics (2020). ASA Physical Status Classification System. American Society of Anesthesiologists. Date. Available from: <https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system>.

13. Australian Institute of Health and Welfare (AIHW) 2020. National Bowel Cancer Screening Program: monitoring report 2020. Cancer series no.128. Cat. no. CAN 133. Canberra: AIHW.

14. Ananda S, Wong H, Faragher I, Jones IT, Steele M, Kosmider S, et al. (2016). Survival impact of the Australian National Bowel Cancer Screening Programme. Intern Med J, 46(2):166-71. DOI: **10.1111/imj.12916.**

15. Australian Institute of Health and Welfare, Australian Government Department of Health. (2016). Analysis of colorectal cancer outcomes for the Australian National Bowel Cancer Screening Program. Asia Pac J Clin Oncol, 12(1):22-32. DOI: **10.1111/ajco.12452.**

16. Mainz J. (2003). Defining and classifying clinical indicators for quality improvement. Int J Qual Health Care, 15(6):523-30. DOI: **10.1093/intqhc/mzg081.**

17. The Association of Coloproctology of Great Britain and Ireland. Guidelines for the Management of Colorectal Cancer. 3rd Edition. Retrieved from: www.acpgbi.org.uk/content/uploads/2007-CC-Management-Guidelines.pdf.

18. Edge SB, Byrd DR, Compton CC, Fritz AG, Greene FL, Trotti A, Eds. (2010). Cancer staging manual. 7th Edition. New York Dordrecht Heidelberg London: Springer.

19. Sobin LH, Gospodarowicz M, Wittekind C, Eds. (2009). TNM classification of malignant tumors. 7th Edition. New York: Wiley.

20. Morris E, Quirke P, Thomas JD, Fairley L, Cottier B, Forman D. (2008). Unacceptable variation in abdominoperineal excision rates for rectal cancer: time to intervene? Gut, 57(12):1690-7. DOI: **10.1136/gut.2007.137877.**

21. Dr Hayat Dagher Associate Professor Susannah Ahern, Dr Farhad Salimi, Associate Professor Arul Earnest, Associate Professor Chris Byrne, Dr Elizabeth Murphy, Mr Mark Thompson-Fawcett, Associate Professor Paul McMurrick, Professor Cameron Platell, Ms Angela Brennan, Professor Chris Reid, Dr Philip Smart, Ms Sze-Lin Peng, Dr Aymen Al-Timimi, Professor Pierre Chapuis, Mr Mark Doudle, Dr Greg Nolan, Dr Anthony Ciccocioppo, Professor Alexander Heriot. The Binational Colorectal Cancer Audit Report 2019. May 2019, pages 58.

22. Lewis OA, McCallum IJ, Dixon S, Katory M. (2015). Long term -ostomy as a quality marker: Comparison of outcomes from a six year series of laparoscopic surgery in MRI defined low rectal cancer. Int J Surg, 23(Pt A):108-14. DOI: **10.1016/j.ijsu.2015.09.054.**

23. Healy MA, Peacock O, Hu CY, Bednarski BK, Tillman MM, Messick C, et al. (2020). High Rate of Positive Circumferential Resection Margin in Colon Cancer: A National Appraisal and Call for Action. Ann Surg. DOI: **10.1097/SLA.0000000000004682.**

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