



Addressing Patterns of Care and Unwarranted Variations in Colorectal Cancer: A Rapid Review of the Current Evidence

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The Victorian Integrated Cancer Services (VICS) are Victoria's cancer services improvement network. They build relationships between healthcare providers and other cancer care stakeholders to develop, implement and evaluate initiatives that improve the way our member health services provide care and support people affected by cancer.

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Abbreviations

Abbreviation	Definition
BMI	Body Mass Index
COVID-19	Novel Coronavirus, 2019 Pandemic
CRC	Colorectal Cancer
CVD	Cardiovascular Disease
CRISP	Colorectal Cancer Risk Predictor
iFOBT	Immunochemical Faecal Occult Blood Test
mCRC	Metastatic Colorectal Cancer
MDT	Multidisciplinary Team
NBCSP	National Bowel Cancer Screening Program
NEMICS	North Eastern Melbourne Integrated Cancer Service
OCP	Optimal Care Pathways
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
VICS	Victorian Integrated Cancer Services

Executive summary

Background

Colorectal cancer (CRC), including bowel, colon and rectal cancer, is a common malignancy in the developed world, with unhealthy lifestyle factors associated with poor nutrition, lack of physical activity, and smoking of tobacco contributing to the rising incidence. In Australia, the introduction of population-wide screening (performed every two years) resulting in earlier diagnosis, and more effective treatments have led to improved survival rates for CRC. In Victoria five-year relative survival has increased for CRC between 1982-1986 and 2017-2021 from 46% to 72%. However, differences exist between Victorians living in the most socioeconomically disadvantaged areas who have a lower 5-year survival rate for CRC compared to those in the most advantaged areas (65.4% versus 76%; 2016-2020). Longer cancer pathways caused by clinical practice and operational issues may contribute to disparities in CRC care and outcomes. Identifying and addressing unwarranted variation can help improve health outcomes, system efficiency, effectiveness, and quality.

Aim

To explore the known patterns of CRC care and what strategies have been used to determine and address unwarranted variations in CRC. Effectiveness of these strategies to address issues in the CRC context were also investigated.

Methodology

The rapid literature search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Articles with the terms 'patterns of care' and 'unwarranted variation' in the context of CRC were searched using three databases: Medline, PubMed and EMBASE. The search was performed on 25 September 2024. The articles selected were original research articles in the English language reporting on patterns of care and unwarranted variation in adult CRC populations published from 2018 onwards. Non-empirical literature such as opinion pieces, descriptions of study protocols for clinical trials, abstracts with no available full-text, case reports, conference abstracts, letters to journal editors and editorials were excluded. Reference searches of the primary articles were also conducted to retrieve additional articles.

Findings

The search yielded 474 studies and 147 were reviewed, of which 86 (including four from the grey literature and 15 identified via snowball searching), met the inclusion criteria. These studies were summarised in a table in the Appendix under the following headings: first author, year, country, study design/duration, objective(s), participants (N), outcomes/results, and key findings. Most of the studies (33 per cent) were retrospective cohort analyses.

The majority of studies in this review described treatment patterns for patients diagnosed with CRC and limited research examined either post-diagnostic surveillance or end-of-life care for CRC. Patients with lower socioeconomic status were less likely to receive treatment, and variations in patterns of care were observed by patient demographic and clinical characteristics, geographical location, and hospital setting.

No studies specific to CRC that met the inclusion criteria were retrieved from this search that discussed a framework to categorise unwarranted variations. This is despite Wennberg's classification framework, being widely cited for understanding unwarranted variation and it being applied to CRC however this study did not meet this review's inclusion criteria because it was published before 2018. Several studies identified strategies that included the application of a range of statistical approaches to determine unwarranted variation in CRC

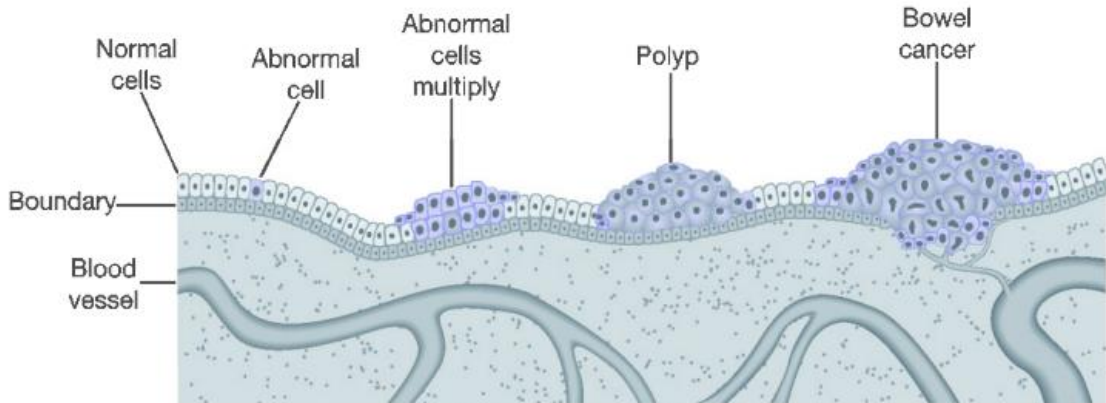
and provided suggestions for how the variations could be addressed.-Despite this, without a clear understanding of the parameters that distinguish 'unwarranted' variation and a lack of consensus on how they are defined and identified meant that there was a lack of distinction as to what constituted unwarranted variations in CRC outcomes.-Limited evidence was found regarding whether any proposed approaches have been-effective noting that none of the studies definitively reported any variation as unwarranted variations.

Conclusion

Without clear operationalisation of frameworks to categorise unwarranted variation, assessing the impact of any interventions or initiatives to address unwarranted variation in CRC care will continue to be challenging. Most of the current literature regarding CRC and unwarranted variations related only to treatment. Data representing the supportive care and palliative care needs of CRC was sparse. As a result, findings of this review demonstrate that unwarranted variations in CRC care are complex and multifactorial, influenced by individual, systemic, and organisational factors. While progress has been made in advancing CRC diagnosis and treatment, persistent disparities in care continue to undermine patient outcomes. Addressing these challenges requires a concerted effort to standardise care pathways, implement evidence-based interventions, and promote equitable access to high-quality care. Future research should prioritise the development and validation of robust frameworks to identify unwarranted variations and assess the effectiveness of targeted interventions.

1. Introduction

Colorectal cancer (CRC), also known as bowel cancer, develops from the inner lining of the bowel and is usually preceded by growths called polyps, which if left undetected can become invasive cancer (Figure 1).[1] Depending on where the cancer begins, CRC/bowel cancer may be called colon or rectal cancer.[2]



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Figure 1. Beginnings of CRC cancer [1]

The most common type of CRC diagnosed is adenocarcinomas (approximately 90%) which start in the glandular tissues lining the bowel. Other less common types of cancer reported that can also affect the bowel include lymphomas and neuroendocrine tumours [2] which may be associated with hereditary syndromes such as Lynch syndrome.[3]

Previous epidemiological analyses have linked modifiable lifestyle factors to CRC.[4] Excess body weight and physical inactivity,[5] smoking,[6] consumption of red and processed meat,[7] and ionizing radiation [8] have all been reported to be associated with increased colorectal cancer risk. Conversely dietary fibre, calcium supplements, dairy products, whole grains, and regular aspirin use have been associated with reduced colorectal cancer risk.[5, 9-14]

In Australia, CRC was the fourth most commonly diagnosed cancer in 2023 (58 cases per 100,000 population), with estimated all-age incidence rates of 66 per 100,000 in males and 52 per 100,000 in females.[15] The incidence rate for bowel cancer is expected to increase with age, highest for those aged 85–89 years.[15] Nevertheless emergent evidence suggests that incidence of CRC in people under 50 years of age is rising in high-income countries[16, 17] including Australia,[18] with survival outcomes varying, based on the stage of disease at diagnosis.[19]

In 2022, 3,504 Victorians were diagnosed with CRC, making it the third most commonly diagnosed cancer, accounting for 10% of all new cases in both males and females.[20] Of the total Victorian CRC diagnoses, 1,814 (51.8%) were males and 1,690 were females (48.2%).[21] Currently, CRC is diagnosed at a rate of 31 per 100,000 males and 24.9 per 100,000 females in Victoria [21] however, CRC rates are anticipated to increase over the next decade.[20] Between 1982 and 2001 the incidence rate of CRC for Victorian males increased by an average of 0.6% per year, declining between 2001 and 2019 to an average of 1.6% per year, and between 2019 to 2022 incidence declined by an average of 5.8% per year.[21] Between 1982 to 1992 the incidence of CRC for females was stable, between 1992 to 2017 incidence declined by an average of 0.7% per year, and between 2017 to 2022

incidence declined by an average of 3.6% per year.[21] Despite the five-year relative survival in Victoria increasing for CRC between 1982-1986 and 2017-2021 from 46% to 72%,[21] socio-demographic characteristics, particularly Indigenous status, cultural background and population ageing have been identified as important drivers of regional disparities in NBCSP participation.[22] As a result, more Victorian Aboriginals are likely to be diagnosed with CRC compared to non-Aboriginal Victorians.[20] The same applies for those living in regional Victorian compared to metropolitan areas (5-year relative survival for 2017-2021 was 72% major cities versus 70% regional Victoria).[20]

Population-based screening can lead to reduced CRC incidence, as well as mortality, through the early detection of both cancer and precancerous conditions.[10] The Australian National Bowel Cancer Screening Program (NBCSP), initiated in 2006 (and fully implemented in 2019) provides free screening to all Australians aged 50 to 74 years using an immunochemical faecal occult blood test (iFOBT).[11] Eligible Australians are sent a CRC screening test every two years via the NBCSP.

Globally CRC is becoming a health threat for young adults (under the age of 50 years), especially because it is often diagnosed in advanced stages.[12] As a result, from 1 July 2024, Australians aged 45-49 years can also request a free screening kit to be mailed to them.[11, 13] Improving participation is acknowledged as a key factor in maximising the health benefits of the NBCSP, including increasing cancer prevention and saving lives.[11] However, a recent Australian study has suggested that up to 30% of individuals who do not return their iFOBT kit may undergo screening or surveillance testing outside of the program.[14] It has been suggested that developing system that integrates patient records and clinical management software to capture and share patients' screening histories with the national register could help address this issue.[14]

Timely access to cancer care is recognised as an important metric of health services delivery of CRC.[23] Early surgical management of cancer often provides the best chance at curative treatment for CRC, as delays may result in progression to locally advanced stages or metastasis at diagnosis and in turn contribute to poor cancer survival.[24] Furthermore, health system and hospital utilisation for CRC is closely linked to the stage of disease at diagnosis, with advanced stages typically requiring significantly greater healthcare resources.[25] A recent Australian study examining health system costs and hospital utilisation for CRC found that participants living outside major cities incurred lower costs during the initial and terminal care phases compared to those in major cities.[25] This variation in care was attributed to potential barriers in treatment accessibility, including challenges related to long-distance travel and the need for accommodation, which may limit access to hospital-based or subsidised follow-up care.[25] In addition, a systematic review examining geographical variations in the clinical management and treatment of CRC in Australia found that studies comparing regional and metropolitan healthcare facilities, rather than patients' residential addresses, generally reported less optimal clinical management in non-metropolitan areas.[26] These findings suggest potential disparities in the quality of treatment provided to patients in regional settings.[26]

In response to the growing cancer burden, the Australian government launched the Australian Cancer Plan in 2023.[27] The plan aims to improve cancer outcomes, particularly for key population groups, including Indigenous and those living in rural and remote areas.[28] The objectives of the Australian Cancer Plan also align with the current Victorian Cancer Plan 2024-2028.[29] A central component of both the Australian Cancer Plan and the Victorian Cancer Plan is the implementation of the Optimal Care Pathways (OCPs).[30] The OCPs are frameworks for the delivery of consistent, safe, high-quality and evidence-based care for people with cancer, according to tumour type including CRC.[31] They cover

every step of the cancer journey from prevention and early detection through to survivorship and end-of-life care.[32] The OCPs aim to address unwarranted variations in cancer care and for equitable care to be provided nationally.

Despite the OCPs endeavouring to reduce unwarranted variations in cancer care, variation still exists. [33] There are multiple, diverse reasons behind variations in clinical practice, reflecting personal, organisational and systemic levels.[34] The reasons why gaps occur between evidence and practice are complex, and efforts to improve uptake are unlikely to be successful if they are one-dimensional or focus on individual health professionals.[34]

The Victorian Integrated Cancer Services (VICS) Optimal Care Summits program (previously known as the Victorian Tumour Summits) is a leading initiative of the VICS and is administered and managed by the North Eastern Melbourne Integrated Cancer Service (NEMICS). The purpose of the Summits program is to identify unwarranted variations in tumour-specific cancer care and cancer outcomes (including clinical practice variation) and to provide recommendations for the VICS to address at the state, network, and/or health service level.

In 2024, the VICS Optimal Care Summits team will begin a mixed-methods, strategic consultation approach to identify and agree priorities for reducing variations (Figure 2) and improving CRC outcomes throughout Victoria. To date, there has been very little synthesis of evidence regarding patterns of care for patients with CRC including the degree of unwarranted variation (deviation from effective care) in CRC care. The 2024/2025 CRC consultation will be overseen by an expert advisory group which will govern the analysis of relevant administrative datasets as well as health record audit data and patient experience information. The expert advisory group will also review the evidence for unwarranted variations across Victoria and outcomes targeted to improve quality of care. For this review, unwarranted variation is defined as the variation in the utilisation of health services that cannot be explained by differences in patient illness or preferences, that is a chance to improve the quality and equity of clinical care.[35] Decision-making and physician preferences are recognised factors in unwarranted variations in care and outcomes.

2. Aim

The aim of this review is to assist the work of the CRC consultation by providing a synthesis of published evidence in relation to the following questions:

1. What are the known patterns of CRC care?
2. What approaches or strategies have been used to (a) identify/determine unwarranted variation, and/or (b) address unwarranted variation in CRC care?
3. What evidence is there of the effectiveness of the approaches identified in addressing unwarranted variation in a CRC care context?

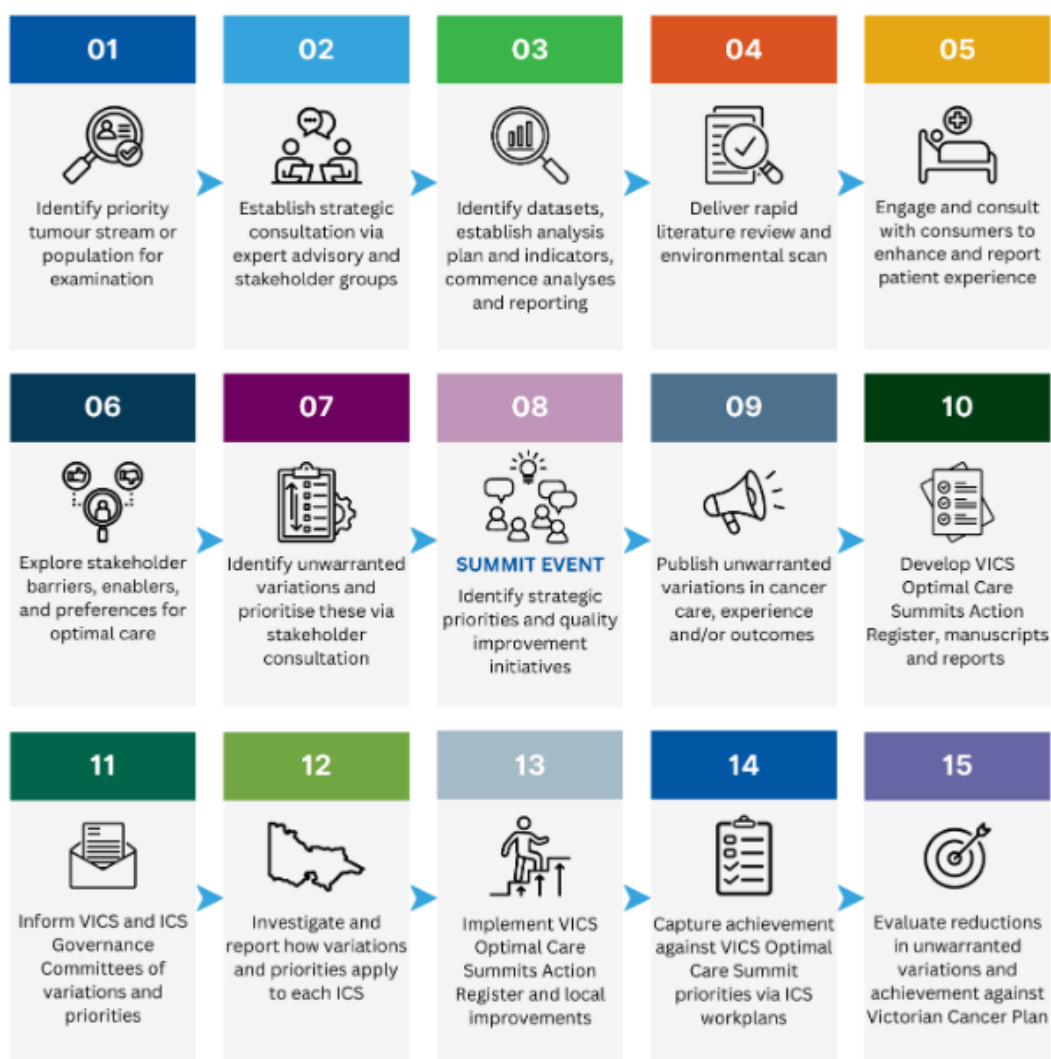


Figure 2. Steps undertaken pre and post of a cancer summit event

3. Methods

A search of databases including PubMed, MEDLINE and Embase was conducted. The search was limited to contemporary literature (2018 onwards), published in English with a focus on any CRC specific care improvements occurring in Victoria and nationally. Grey literature searches were conducted through targeted internet searches of state and federal government health websites, web search engines (Google), non-government cancer associations (e.g., state Cancer Council groups, Bowel Cancer Australia, Bowel Cancer Research Foundation Australia and Bowel Screening Alliance, Colorectal Surgical Society of Australia and New Zealand (CSSANZ)) websites, and manual hand searching of reference lists of included studies. An internal review of the draft literature review yielded an additional reference. [36] The review was undertaken using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[37] The search strategy is presented in Table 1.

2.1 Eligibility criteria

2.1.1 Inclusion criteria

- *Population*: adults (18 years and older) diagnosed with CRC.
- *Types of publication*: Publications in English language that report original primary empirical work published since 2018.
- *Types of settings*: Public or private hospitals, general practice or other primary/community care facilities including Australian.
- *Types of study design*: Conceptual, theoretical, quantitative or qualitative studies of any research design.
- *Outcomes*: any measurement against the OCP framework.
- Data regarding the identification and/or assessment of unwarranted variation in relation to any health care outcome specific to CRC.

2.1.2 Exclusion criteria

Non-empirical literature such as opinion pieces, descriptions of protocols for clinical trials, abstracts with no available full-text, case reports, conference abstracts, letters to journal editors and editorials.

2.2 Data extraction and synthesis

After the inclusion criteria was applied to titles and abstracts (including executive summaries of grey literature) of full manuscripts that were reviewed using Covidence, a systematic review workflow management system (<https://www.covidence.org>), the following data were extracted: first author, year, country, study design/duration, objective(s), participants (N), outcomes/results, and key findings.

Findings were analysed using a narrative empirical synthesis in stages based on the review questions. Initial descriptions of eligible studies and results were tabulated for CRC (Table 2) and divided by the seven-step OCP for CRC.[31] Patterns in the data were explored to identify any consistent findings in relation to the study questions. Interrogation of the findings explored the influence on different outcome measures, methods, and settings on the resulting data.

3. Results

3.1 Results of the search

After removing duplications, 474 studies were identified. Title and abstract screening resulted in 147 studies that fulfilled the inclusion criteria for which full text of the manuscript was reviewed. A total of 86 studies were included in the review based on the inclusion and exclusion criteria. This included 67 studies identified from the database full text review, four studies retrieved from the grey literature and 15 further studies identified via snowball searching as shown in Figure 3. Table 1 includes a summary of the included publications. The included studies were reported from 18 countries (Figure 4): United States (24), Australia (14), United Kingdom (12), Canada (6), The Netherlands (5), China (3), Germany (3), Malaysia (2), Sweden (2), Brazil (1), Denmark (1), Finland (1), France (1), Italy (1), Norway (1), Pakistan (1), Singapore (1) and Spain (1). There were six international studies. Twenty-seven studies (33 per cent) presented were specific to the optimal care pathway Step 4: Treatment, followed by 23 (28 per cent) for Step 1: Prevention and early detection, 12 (15 per cent) for Step 5: Care after initial treatment and recovery, 6 (7.4 per cent) for Step

3: Diagnosis, staging and treatment planning and 5 (6.3 per cent) for Step 6: Managing recurrent, residual or metastatic disease, 3 (3.7 per cent) for Step 2: Presentation, initial investigations and referral and 2 (2.5 per cent) for Step 7: End-of-life care. Four studies (5 per cent) focused on variation in the incidence rate of CRC.

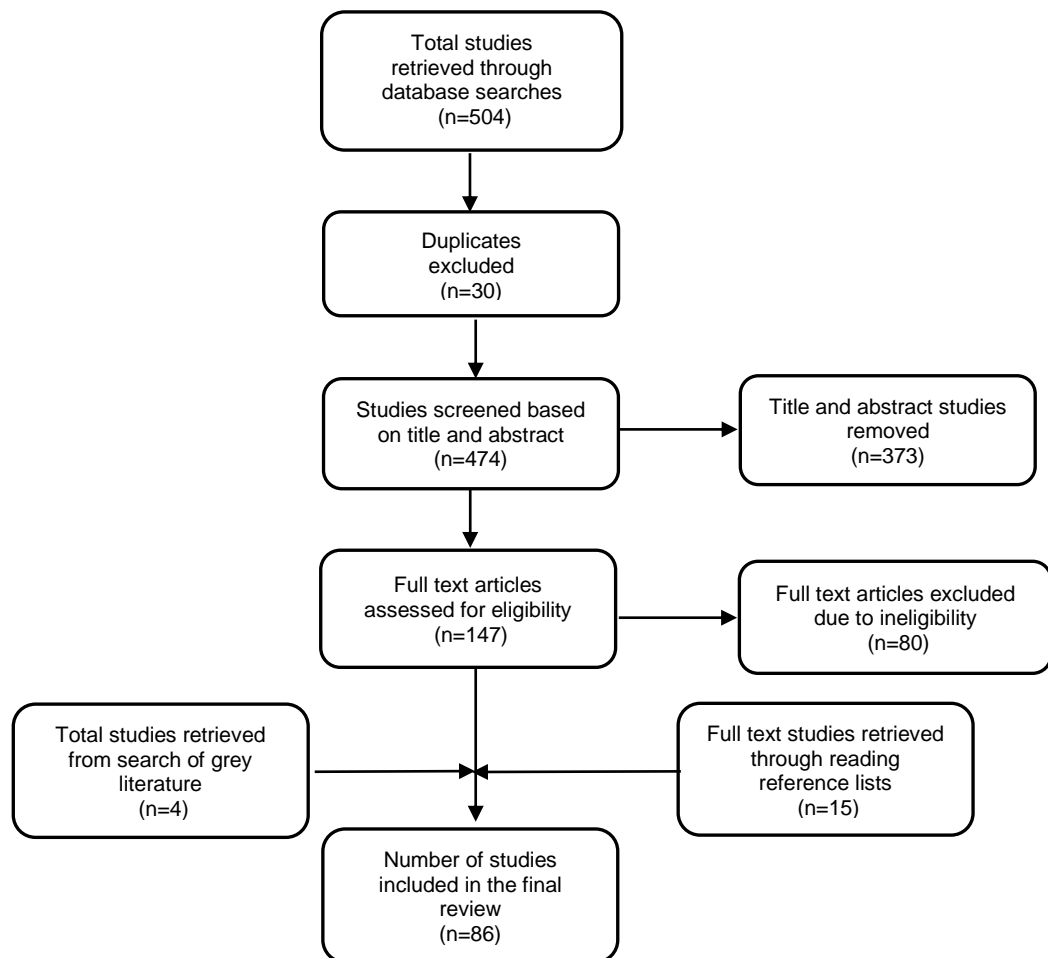


Figure 3. Flow diagram showing the selection process

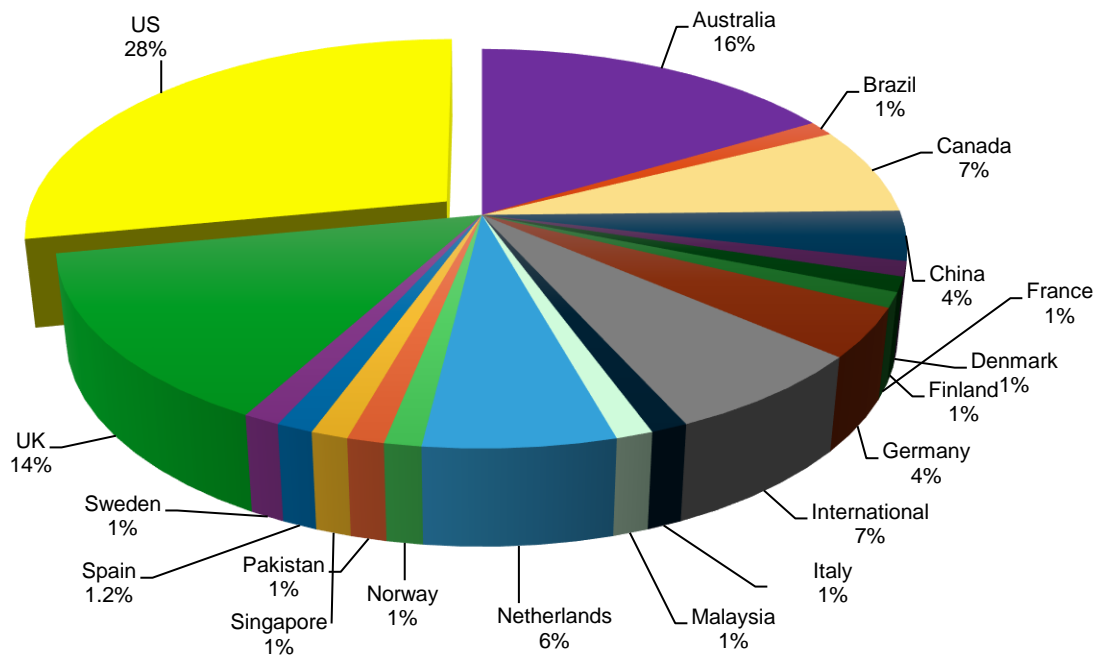


Figure 4. Percentage of studies by country

3.2 Review findings

3.2.1 What are the known patterns of CRC care?

The pattern of care for patients diagnosed with CRC includes a variety of primary treatments options, depending on the cancer's stage and location, as well as the patient's preferences.[38] However, these options are also influenced by demographic and clinical factors including age, co-morbidities and tumour site.[39] Studies that have evaluated the adoption of therapies and temporal changes in patterns care show that for the majority of CRC patients, surgery remains the primary therapy with surgery techniques having changed considerably for both colon and rectum cancer over the past decades.[40] Despite this, adjuvant therapies such as chemotherapy and radiotherapy, and neo-adjuvant radio-chemotherapy have emerged as standard care depending on stage and site of disease.[39] An increasing body of international and local evidence suggests some subgroups may experience less than optimal treatment [39, 41-47] including circumstances where patients in the most disadvantaged areas less likely to begin adjuvant chemotherapy within 8 weeks after surgery, compared to those in the least disadvantaged areas.[42] Other studies have shown that the provision of neoadjuvant/adjuvant therapies may be less than optimal.[39] An Australian study examining broad patterns of CRC management (surgery, radiotherapy and chemotherapy) across all stage and sites, with statewide coverage of both public and private health care services, found notable age-related disparities in treatment. Radiotherapy was less commonly administered to older patients (prevalence ratio 0.7, 95% confidence interval 0.5–0.8).[39] Similarly, chemotherapy usage was lower among older adults (0.7, 0.6–0.8), individuals with severe or multiple co-morbidities (0.8, 0.7–0.9), and those from rural areas (0.9, 0.8–1.0).[39] These findings are not limited to Australia, treatment patterns for older CRC patients from the Netherlands revealed that, irrespective of cancer location or stage, older patients received less frequently a combination of surgery and (neo)adjuvant therapy compared to younger patients (decreasing from 55% to 1% in colon cancer patients, and from 71% to 23% in rectal cancer patients aged <65 years and ≥85 years respectively).[48]

These findings underscore the need for further research to better understand age-related differences in treatment patterns and improve insight in the treatment decision-making process.[48]

Colonoscopy remains the primary diagnostic tool for CRC. However, approximately 25% of patients present with metastatic disease at diagnosis, and nearly half will develop metastases during the disease course.[49] Advances in systemic treatment and management, guided by clinical practice guidelines, have improved the clinical outcomes of metastatic CRC (mCRC) over the last decade.[50] Nevertheless, studies have revealed that treatment patterns in patients with mCRC may exhibit significant variability across and within countries, influenced by adherence to guidelines, healthcare access, and the introduction of screening programs.[50]

Treatment disparities are also linked to hospital service volume (SV); high-volume hospitals are more likely to overtreat, while low-volume hospitals risk undertreatment. Older patients and those facing socioeconomic challenges often have limited access to advanced treatments, such as targeted biologics, due to high costs and systemic barriers.[51, 52] For instance, delays in initiating combination therapies for Chinese mCRC patients have led to suboptimal outcomes. This finding raises a major concern about the delayed initiation of combined therapy among Chinese mCRC patients, which may consequently lead to suboptimal treatment outcomes.[52, 53]

Metastatic CRC also serves as an excellent surrogate for assessing hospitals service volume (SV).[54] One study found that hospital-level SV of patients with mCRC is a significant indicator of nonstandard treatment patterns among patients with stage I-III colon cancer. Hospitals with the highest volume of cancer treatments were shown to have higher odds of providing overtreatment, while low SVs were associated with higher odds of under treatment.[54]

Current treatment patterns and outcomes in early-onset CRC patients is unclear.[55] Studies which have reviewed CRC patient care in community-based settings to compare treatment patterns and survival among early- and late-onset CRC patients receiving care have found that early-onset CRC patients were more likely to have >12 lymph nodes examined and more likely to receive systemic therapy than late-onset patients.[56] Furthermore, the researchers also found that although early-onset patients were more likely to present with aggressive tumour characteristics, they tended to have a better survival than late-onset patients.[56]

Previous population-based studies analysing national CRC incidence and death rates have observed significant increases in the crude and age-standardised rates and survival of CRC across the last two decades.[57] However, it is unclear whether this rise represents a real increase in the disease itself.[57] A possible explanation for this observed increase is that more CRCs are being detected in response to increased patient awareness, changing referral patterns and an increase in 'on demand' screening.[57] Despite this geographical variation in the survival of CRC patients has been observed in several studies conducted in developed and developing countries.[58-66] A Norwegian population-based study of women found that country-level differences in CRC incidence were not explained by differences in lifestyle-related CRC risk factors and found a possible link to inheritable factors.[65] Thus, the family history of CRC cases may be especially important in determining appropriate preventive screening strategies in areas of high incidence.[65] Findings of an American study showed that county-level indicators of socioeconomic background such as median income significantly explained geographic heterogeneity of CRC incidence rates.[63] Another study which investigated how individual and socioeconomic factors might affect

survival from CRC after adjusting for geographic location indicated wide variation across Malaysia.[58] A nationwide US data analysis covering nearly 98% of the US population, revealed a temporal variation in the incidence changes in early-onset CRC across different geographical regions.[61] In this study results demonstrated that early-onset CRC incidence rates and time trends increased in men and women across different regions in the US, with the steepest increase noted in the west and the least in the south.[61] These findings persisted across both main CRC histopathological subtypes (adenocarcinoma and neuroendocrine tumours) with neuroendocrine tumours showing a more pronounced increase compared to adenocarcinoma, especially in the west and northeast.[61] These findings highlight significant geographical, socioeconomic, and biological disparities in CRC incidence and survival, emphasising the need for tailored public health strategies, equitable resource allocation, and personalised screening programs to address these inequities and improve outcomes globally.

An American study observed that the lack of decline in CRC incidence among Asian Americans in the Midwest and South was likely driven by screening disparities influenced by variations in health care access and health attitudes.[66] Similarly, a comparative study between Scotland and Denmark highlighted that limited access to general practitioners for CRC in both countries was associated with later stage diagnosis and poorer survival, emphasising the sensitivity of treatment pathways to differences in national healthcare systems.[59] Additionally, a grey literature thesis which utilised a CRC risk index found that greater distances to health services were associated with worse outcomes for patients diagnosed with CRC.[60] These findings show the critical role of healthcare accessibility in improving patient outcomes.

Another study observed disparities in CRC survival in England among more than 16,000 people diagnosed with CRC between 2010 and 2014. The lowest 5-year relative survival varied by over 5 percent from 63.5% in the Southwest to 58.1% in Trent and the Northwest, the latter which were significantly more deprived than the regions with better outcomes.[64] Existing research has quantified the geographical variation in survival using geographical regression software to conduct global and spatial analysis in relation to CRC screening.[62] The global regression results of an Australian study showed that higher rates of screening participation were associated with employment/education disengagement and volunteering while in contrast, lower rates of participation were associated with higher rates of Indigenous populations, people with chronic health conditions, and people with poor English skills.[62]

Globally CRC screening is recognised as likely to have contributed to the declines in incidence and mortality over the past two decades.[67] For example, in Sweden the implementation of a regional CRC screening programme lowered the peak population frequency of colonoscopy incidence from 70–74 years to 64–69 years for the period 2006–2015.[45] Despite this, regular CRC screening which is recommended for all adults aged between 50 to 75 years is only offered to a small proportion of the target population worldwide.[68] Even within countries that have implemented a screening programme, complex patterns of variation in CRC screening utilisation exist.[69] A Scottish study reported ethnic variation in CRC screening with pronounced lower screening uptake among the South Asian groups compared with the White Scottish population, and higher uptake among the Chinese and other White British populations.[69] Identifying potential barriers to CRC screening is critical, and more so among culturally diverse populations, to allow for the development of targeted interventions.[70]

Another Scottish study examining sex differences in CRC mortality revealed that despite higher CRC screening uptake in women compared to men, this did not translate into improved outcomes for women, as their CRC detection rate was lower than that of men.[71]

This disparity suggests a greater beneficial effect of screening on CRC mortality in men and indicates that employing sex-specific thresholds for screening could help achieve more equitable outcomes.[71]

Few studies have assessed adherence to CRC screening among individuals with a personal or family history of CRC, with some reporting higher screening uptake in this group.[72] In contrast, a Canadian study found that non-adherence to screening programs was significantly higher among individuals with a personal or familial CRC risk compared to those at average risk.[73] This study emphasises the need for further research to understand the patterns and predictors of suboptimal adherence to screening programs.[73] Emery et al., 2023 argue that utilising risk models that account for family history, lifestyle, and medical history could tailor CRC screening, optimising the starting age and choice of screening test, and potentially proving more cost-effective than universal population screening.[74] Their randomised controlled trial found that using the Colorectal cancer RiSk Prediction (CRISP) risk tool in general practice increased risk-appropriate CRC screening in patients due for screening, though its effect was less clear among those who were up to date with screening.[74] The CRISP intervention could be beneficial for individuals in their fifth decade, ensuring CRC screening begins at the optimal age with the most cost-effective approach.[74]

Emerging data suggests that the COVID-19 pandemic dramatically impacted the pattern of CRC care globally, including Australia and affected various stages of the care pathway.[75-77] One study assessed these disruptions, focusing on changes to treatment patterns and challenges that could lead to deviations from standard care.[75] The findings revealed a 38.5% and 33.4% reduction in colonoscopies and esophagogastroduodenoscopies (EGDs) performed during the pandemic, equating to a loss of 2.7 and 2.4 months of pre-pandemic productivity. Furthermore, 30% fewer colorectal cancers than expected were diagnosed.[76] A second study highlighted how the pandemic-related restrictions exacerbated existing disparities in colonoscopy rates between whites and African Americans, with unequal access to colonoscopy being a likely factor.[77] This finding is concerning as African Americans face a higher risk of developing CRC than other racial groups.[77] A third study which examined the impact of COVID-19 restrictions on CRC care during the pandemic highlighted significant variations in CRC surgery practice within the UK and inconsistent adherence to protocols.[75]

Patterns of care for post diagnostic surveillance of CRC were reported in four studies [47, 78-80]. Two Australian population-based surveys evaluated the content of follow-up visits during the first three years after treatment and compared them to survivorship guidelines. Although survivors received regular follow-up in the first year, the documentation often failed to address broader aspects of survivorship care.[78] Furthermore, less than half of the patients received guideline-recommended surveillance colonoscopies or carcinoembryonic antigen (CEA) assays one year after their diagnosis.[47] The authors concluded that this observation contributes to a growing body of evidence suggesting that clinical practice remains focused primarily on detecting disease recurrence, rather than expanding to encompass the full scope of care outlined in survivorship care guidelines.[78] This highlights the need for greater health promotion efforts to ensure optimal survivorship care for all patients, regardless of their socioeconomic status.[47]

Recent evidence suggests that physical activity is associated with higher overall, as well as disease-specific survival in individuals with CRC.[81] For CRC patients, meeting guidelines pre-diagnosis was the only significant predictor of meeting guidelines post-diagnosis ($p < 0.001$).[79] Further analysis from this study revealed that breast cancer patients were more likely to comply with physical activity guidelines post-diagnosis than prostate and female

CRC patients suggesting the need that physical activity should be recommended more frequently in this period.[79]

Survivorship care plans (SCP) should outline patient information about cancer treatment and follow-up.[82] Key findings from a study identified in this review, which investigated SCP content for CRC patients highlighted variability in follow-up recommendation between health services.[80] This variation between sites may be explained in part by the SCP template at each site and by patient and treatment-related factors.[80] The authors suggested a role for standardised templates to help with uniformity and guideline concordance of recommendations to address variation in the content including essential cancer details and follow-up recommendations for CRC patients.[80]

Few studies in this literature review addressed end-of-life care for CRC patients.[83, 84] Of the two studies identified, one Australian study of CRC patients in South Australia highlighted that palliative care services are not equally distributed, with more access for patients from higher socioeconomic backgrounds or metropolitan areas, compared to those in remote regions.[83] A likely explanation for this disparity is that palliative hospices are typically located in major cities.[85] Similarly, an American study also indicated that despite the increasing use of palliative care for patients with CRC sociodemographic factors, as well as regional and hospital characteristics, influence access to these services.[84] These findings highlight the need for standardisation in palliative care practices to better mitigate variability in evidence-based use of palliative care nationwide.[84]

3.2.2 What approaches or strategies have been used to (a) identify/determine unwarranted variation and/or (b) address unwarranted variation in CRC care?

No studies specific to CRC cancer were retrieved from this search that discussed conceptual or theoretical frameworks such as Wennberg's classification framework, which is widely cited for understanding unwarranted variation.[86] However, a 2016 study examined antecedents in CRC clinical pathways against Wennberg's framework, exploring instances of effective, preference-sensitive and supply-sensitive care with an emphasis on the multidisciplinary team (MDT).[87] The researchers highlighted variations in effective care and suggested that investigation of the CRC pathway may assist to identify points where unwarranted variations occur, enabling pragmatic, focused interventions.[87] For variations specific to patient preference, Menon et al (2016) suggest that unwarranted variation often arises when patients are unable to make informed decisions regarding their "preferences".[87] They emphasised that clinical consultations focusing on relevant treatment options, setting realistic expectations, and defining clear patient outcome goals could help reduce unwarranted variations.[87]

Despite no studies describing theoretical frameworks that classified unwarranted variation in CRC care meeting the inclusion criteria, two groups of studies reported approaches to determine unwarranted variation in CRC care and provided suggestions for how it could be addressed. The first group (four studies) applied a mixed methodological approach to determine key organisational factors to target and improve CRC patient care using population level data [88-91]. The second group of 78 studies applied a broader range of descriptive statistical analyses including statistical models, most commonly regression analyses [22, 42, 43, 45-47, 51, 54, 56, 59, 62, 66, 69-71, 73, 74, 79, 84, 91-113], to identify variation that was considered to have deviated at a statistically significant level from an unexpected level of uncertainty.

3.2.2.1 Mixed methods based unwarranted variation identification

The database search identified four studies that employed a mixed-methods approach, combining quantitative and qualitative research to investigate causes of clinical variation in: repeated faecal blood testing following an initial positive result rather than proceeding directly to colonoscopy,[88] timely diagnosis at primary care level [89], and use of chemotherapy.[91]

The first study used mixed-methods approaches for a deeper understanding of repeat testing by documenting the pattern of testing (via quantitative data) and exploring behavioural factors (qualitative data).[88] A large cohort of patients (n=23,312), aged 50-89 years from four state health services who had a positive faecal test from 2010-2018 were explored. Qualitative interviews with physicians and patients showed that only 7.4% repeated faecal testing after an initial positive test.[88] Of those, over half did not go on to receive a colonoscopy within one year.[88] Efforts to improve CRC screening need to address repeat faecal testing after a positive test.[88]

In the second study, quantitative and qualitative methods were used to investigate patients' accounts of early-onset CRC diagnosis, published on prominent CRC (bowel) cancer support websites in the United Kingdom, Australia and New Zealand.[89] Across all three countries, barriers to timely diagnosis were reported in three key areas faced by CRC patients in three key areas: clinical assessment; continuity of care; and patient-centredness of interpersonal interactions.[89] A notable finding was that these barriers often stemmed, at least in part, from patients' limited understanding of the guidelines that steer diagnostic decision-making.[89] Patients perceived their GPs' low suspicion of cancer given age under 50 as an age bias that contributed to delays.[89] The researchers concluded that addressing this perception through patient-GP discussions and providing information about diagnostic protocols could enhance the diagnostic experience.[89]

Researchers of a third study used a mixed-methods approach to quantify the variation in adjuvant chemotherapy treatment for CRC across England.[91] They found a surprisingly high variation in chemotherapy rates for high-risk stage II patients, and suggested this difference resulted in part from clinicians' differing opinions about the effectiveness of chemotherapy for this cohort.[91] The researchers highlighted regional differences in treatment practices to reach a consensus on a standardised algorithm for guiding chemotherapy use.[91]

Finally, a French study utilised a novel statistical technique in the form of a mixed effects model for the analysis of more complex data to examine variations in adherence to CRC guidelines between centres.[90] They investigated if variations could be explained by differences in patient characteristics, geographical regions, or centre characteristics.[90] This study looked at differences between centres in following three guidelines over time: (1) checking at least 12 lymph nodes for stage II patients, (2) prescribing chemotherapy for stage III patients, and (3) testing the KRAS gene in stage IV patients.[90] Researchers also considered patients' socioeconomic status using a social deprivation index [89]. They found that older guidelines were followed more consistently than newer ones. There was no difference between centres for chemotherapy in stage III, but academic centres had lower adherence. Differences between centres were found for the other two guidelines, but socioeconomic status did not affect clinical practices.[90]

3.2.2.2 Statistically defined unwarranted variation identification

A second group of studies applied a range of statistical methods for the systematic identification of variation and the identification of factors that either directly identified or

provided an indication of potential unwarranted variations. Studies employed prospective (n=4) or retrospective (n=40) cohort analyses using either hospital or population data, cross-sectional (n=9), ecological trend analysis (n=3), randomised control trials (n=2) and longitudinal research designs (n=2). Five studies applied a descriptive qualitative approach using survey questionnaires (including online) [75, 101, 114-116] to determine variations in CRC care. Twenty-eight studies only employed simple descriptive statistics (mean and standard deviation) and comparative tests such as the chi-squared test or Fisher's exact test for continuous variables [48, 50, 52, 53, 61, 64, 65, 75-78, 80, 114-130]. In five studies Bayesian statistical models were used [58, 63, 131-133] compared to 41 studies which utilised multiple regression models to adjust for covariates and to explore potentially significant variation between different factors and categorised according to evidence-based guidelines or accepted definitions of appropriate care [22, 42, 43, 45-47, 51, 54, 56, 59, 62, 66, 69-71, 73, 74, 79, 84, 91-113].

Findings often demonstrated significant variations, such as differences in CRC care by age and comorbidity [106], CRC screening rates among patients of different GPs [110], factors contributing to non-adherence to CRC screening [73], and variation between morning and afternoon colonoscopies in European screening.[108] In addition, hospital performance (postoperative mortality and anastomotic leakage) after CRC surgery [107], practice variability among gastroenterologists in CRC surveillance and management of colorectal dysplasia in inflammatory bowel disease [101], colonoscopy quality [100] and variation in treatment over time [51] were also found. However, these studies did not confirm these variations as unwarranted.

3.2.2.3 Addressing unwarranted variation

Overall, studies generally focused on identifying and defining unwarranted variations rather than addressing them. One approach to address unwarranted variation and the quality of CRC care was to explore the impact of audit and feedback approaches. Dinger and colleagues explored regional variance in treatment and outcomes of patients with locally advanced rectal cancer in Australia and New Zealand.[120] From their data, the authors' revealed an overall circumferential resection margin (CRM) positivity rate of 6.4% for all rectal cancers.[120] This was lower compared to other national audits such as the Dutch Surgical Colorectal Audit which reported CRM positivity rates of 7.9% [134], and the United Kingdom National Bowel Cancer Audit (8.2%).[135] Positive CRM is well documented as being an important prognostic factor for rectal cancer recurrence and poor survival.[136] Locally invasive T4 (that is a tumour that has spread to nearby tissues or organs) rectal cancer often requires neoadjuvant treatment followed by multi-visceral surgery to achieve a radical resection (R0) and referral to a specialised exenteration quaternary centre is generally recommended.[120] The results of this study highlight that patients with T4 rectal cancer are at particularly risk, which further supports the concept of referral to specialised exenteration centres for potentially curative multi-visceral resection.[120]

The value of feedback approaches was explored through study designs such as online surveys [75, 114, 116]. For example, feedback from one survey that was aimed at all members of a multidisciplinary team (MDT) provided an insight into variations in the definitions of microscopically positive margins used in everyday clinical practice.[116] One of the study's most interesting findings was the marked variation in how microscopically positive margins were defined by respondents.[116] While the majority of respondents defined these margins as the presence of cancer cells $\leq 1\text{mm}$ of the margin, which was in keeping with the proposed uniform definition of margin status, roughly 1 in 5 respondents defined a positive margin as being directly involved by cancer cells, in keeping with the

previous definition.[116] Discrepancies in the definition of a margin status is cause for concern as a lack of common terminology will likely lead to negative consequences, particularly as margin status is often used as a marker of surgical quality.[116] These findings suggest that more needs to be done to standardise the definitions and reporting of microscopically positive resection margins in patients with CRC.[116] The adoption of an international dataset for pathology reporting could assist to standardise current practices.[116]

Other mechanisms that were used to address unwarranted variation included the use of time-series data from 19 cancer registries in seven countries. This data was benchmarked against inclusion criteria for CRC patients diagnosed during 2010-2014.[41] Variation in stage distribution of colon and rectal cancers were observed, with large proportions of cases with localised colon or rectal cancers in Norway and Australia (also the UK for colon cancer) and small proportions with metastatic cancers in Australia and Canada (also Ireland for rectal cancer).[41] Furthermore, while survival differences across countries were evident for all stage groups, large variation was observed for received treatment regional and locally advanced disease.[41] The results of this study suggests that suggest that survival disparities across countries may be partly explained by differences in treatment and management of regional and distant colon and rectal cancers, and by earlier diagnosis in some countries.[41] Future research into the role of screening programs as well as into factors influencing treatment decision-making by countries is warranted to identify the drivers behind the observed survival differences.[41]

The role of national quality registries in quality improvement was explored in one study.[76] The authors explored the use of quality registry data amongst a large number of geographically diverse endoscopy practices throughout the United States as a strategy to identify variation.[76] Among 451 sites with 3,514 endoscopists, the average monthly volume of colonoscopies and esophagogastroduodenoscopies dropped by 38.5% and 33.4%, respectively between January 2019 and September 2020.[76] There was regional variation, with the greatest and least decline in procedures in the Northeast and South, respectively.[76] These findings indicate that national quality registries can provide data that, when used in feedback to hospital staff and administrators, can provide the basis for identifying and discussing variations and appropriate responses. For example, the change in volume of colonoscopy and esophagogastroduodenoscopy performed across sites in the United States was identified as useful in the development of models to predict delays in care.[76]

The influence of care coordination on adherence to guidelines was another approach used to identify unwarranted variation in CRC. In Australia, adequately documented pathways such as Optimal Care Pathways (OCP) [30] have been developed with the aim of addressing unwarranted variations in cancer care and for the provision of equitable care nationally. In 2017 (revised in 2021) a CRC OCP was developed [31] however, up until recently there was limited research from Australia regarding concordance with OCP recommendations. In one study the authors used survey data from Victorian patients, their general practitioner (GP), and specialist, to examine concordance between care received and recommended components of diagnostic and treatment pathways as listed in the OCP.[42] The authors' findings reported low concordance for several CRC OCP recommendations.[42] Only 13% of GPs performed a digital rectal exam, only a third of patients were presented at an MDT meeting prior to treatment and a third to two-thirds did not receive care within recommended OCP timeframes.[42] Bergin et al., 2019 also identified variation for at-risk populations, with receipt of GP tests generally higher, but waiting times longer for rural, the most socio-economically disadvantaged and public

patients.[42] Significant differences were found indicating longer waiting time to colonoscopy for rural populations and adjuvant chemotherapy for low socio-economic groups.[42] These findings identify key components of the pathway for improvement and populations at risk of suboptimal care.[42]

The impact of a health care system on cancer care and thus patient outcomes may be an important contributor to unexplained variation which can occur between different groups. A Victorian study showed that alignment with a set of measures based on the principles of the CRC OCP was independently associated with improved colon cancer survival.[113] The fact that alignment with the diagnostic and initial treatment phase was associated with better OCP alignment in later stages of the OCP, (that is follow-up care and end-of-life care), suggested a possible 'health service effect'.[113] The authors' highlight the need to address the organisation and coordination of cancer care across the entire health system to embed practices consistent with pathways representing optimal care for CRC.[113]

Another study which analysed the treatment and care for CRC in regional/rural Southwest Victoria, Australia and deviations from the CRC optimal recommendations showed that more patients who held private health insurance (PHI) received treatment and care within the required time frames set out in the CRC OCP had better short-term survival.[130] For example, the authors' reported a higher proportion with PHI survived the first 12 months post-diagnosis, had a colonoscopy within 4 weeks and their first surgical consultation within 2 weeks.[130]

The grey literature search identified three unpublished theses [60, 137, 138] which discussed approaches for addressing unwarranted variation specific to CRC. All three theses highlighted variation in healthcare processes that are unrelated to patient needs, differ from evidence-informed guidelines, compromise patient care, create inefficiencies, and contribute to health inequality. The first of these theses [60] provides evidence of geographic and social variations in CRC incidence, survival and mortality in England and Wales. Spatial variation in CRC mortality was observed, but there was no clear pattern by local authority or area deprivation. A stronger association was found between individual socio-economic attributes (educational attainment, social class and housing tenure) and both CRC incidence and survival.[60] The CRC risk index revealed greater distance to health services and green space was associated with worse CRC outcomes and closer proximity to retail outlets was associated with better CRC outcomes.[60] No associations of the risk index and stage at diagnosis were found.[60] Understanding geographical and social variations in CRC is important to inform policies and target interventions to reduce inequalities.[60] Access to up-to-date data is essential to monitor current health outcomes, while combining more traditional datasets with novel data offers potential to examine these relationships in more detail.[60]

The second thesis [137] concluded that increasing trends in wait times for colon and rectal cancer treatment are associated with increased healthcare costs for patients living in Manitoba, Canada. Among hospitals performing curative resection for CRC, the average rate of postoperative morbidity and mortality varied significantly.[137] Hospitals with higher average rates of morbidity and mortality had increased healthcare costs.[137] Finally, among patients dying of CRC in Manitoba, there appeared to be an underutilisation of palliative care, and patients who did not receive palliative care experienced increased healthcare utilisation and costs at end of life.[137]

The third thesis [138] identified six diagnostic pathways for Canadian CRC patients (asymptomatic, colonoscopy, imaging and colonoscopy, imaging alone, imaging and emergency presentation and no pre-diagnostic workup).[138] Patients who went through a

pathway that was more adherent to diagnostic pathway guidelines (e.g. asymptomatic pathway) were more likely to be younger, healthier and living in less deprived areas, and they tended to be diagnosed at an early stage with a short diagnostic interval.[138] Patients who were female, older, living in more deprived areas and with more comorbid disease were more likely to go through pathways that were divergent from guidelines.[138] The length of the diagnostic interval was correlated to the number of colorectal cancer diagnosis-related visits occurring during the interval.[138] The author concluded that further research is needed regarding the healthcare resource allocation in the Canadian regions where patients are diagnosed ineffectively.[138]

An internal peer review of this literature review yielded a report which summarised the data analyses prepared for the 2018 Colorectal Cancer Summit.[36] In Victoria, the purpose of the Summits program is to identify unwarranted variation in tumour-specific clinical practice and cancer outcomes, and to provide recommendations for the VICS to address at the state-level, network, and/or health service. Data presented in this report focuses on the presentation, diagnosis and treatment steps of the CRC OCP. Stakeholders prioritised variation based on their potential impact on patient experiences and outcomes however there is no description of the criteria used to prioritise unwarranted variation.[36] Eight key variations for local action were identified by an integrated cancer service which mainly focused on treatment and survival of stage IV colon cancer (Table 3).[36]

3.2.3 What evidence is there of the effectiveness of the approaches identified in addressing unwarranted variation in a CRC care context?

Shared decision-making has been identified as the key to reducing unwarranted variation in preference-sensitive care categories.[86] In this literature review, shared decision making was identified via one study [117] as an approach in addressing unwarranted variation but did not specifically provide evidence that their approach was effective. Trogon et al 2018 used multi-payer claims-based, shared patient network measures to investigate the influence of care coordination on adherence to guidelines, survival, and utilisation among CRC patients in North Carolina, United States.[117] Findings suggest that team experience matters for patient's quality of care, utilisation, and outcomes.[117] The experience of the surgeon and medical oncologist team was independently positively associated with patient receipt of guideline-concordant care.[117] This suggests that having surgeon-medical oncology care teams can improve outcomes, even in setting where surgeon volume is low.[117] The clinical pathway has an important role in the management of interpatient variability.[87]

4. Implications

Although this rapid literature review made efforts to evaluate existing literature on patterns of CRC care and approaches used to identify/determine unwarranted variation in CRC care, some limitations should be noted. The search terms and criteria used may have unintentionally resulted in exclusions of relevant studies. However, in an effort to maximise inclusion of relevant studies, reference lists of journal manuscripts which met the criteria were hand searched to identify additional manuscripts. In addition, manuscripts were limited to those published in English, which may have excluded relevant studies published in other languages. Furthermore, the most notable was the absence of sufficient evidence to address two out of the three questions.

This rapid literature review underscores critical patterns and challenges in CRC care, with a particular focus on unwarranted variations across the care continuum. These variations, which span diagnosis, treatment, and survivorship, have significant implications for both

patient outcomes and the healthcare system. The lack of a standardised framework to define and categorise unwarranted variations limits the ability to identify and address inefficiencies effectively. Without clear operational definitions, efforts to evaluate and improve care pathways remain inconsistent, particularly in vulnerable populations. The findings highlight the pressing need for targeted interventions aimed at addressing disparities driven by socioeconomic status, geographic location, and demographic factors.

From a policy and systems perspective, initiatives such as the OCPs provide a promising framework for guiding evidence-based care. However, their inconsistent implementation, particularly in rural and socioeconomically disadvantaged areas, indicates the need for more robust strategies to ensure equitable adherence. Stakeholder engagement, encompassing both patient participation in decision-making and enhanced collaboration among healthcare providers, is essential to bridge these gaps. Additionally, tools such as personalised risk prediction models hold potential for improving screening uptake and tailoring care, but their deployment must be guided by equity considerations to avoid exacerbating existing disparities.

The review also reveals significant limitations in the current body of evidence. Notably, the scarcity of studies employing established frameworks, such as Wennberg's classification, restricts the ability to differentiate between warranted and unwarranted variations. Furthermore, much of the existing research relies on retrospective and cohort studies, which, while valuable, provide limited insights into the real-time dynamics of care delivery. The review also highlights a critical gap in understanding the role of palliative and supportive care in CRC management, which remains sparsely represented in the literature. Geographic and publication biases, with the majority of studies originating from high-income countries, further constrain the applicability of findings to diverse global settings.

In conclusion, this review demonstrates that unwarranted variations in CRC care are complex and multifactorial, influenced by individual, systemic, and organisational factors. While progress has been made in advancing CRC diagnosis and treatment, persistent disparities in care continue to undermine patient outcomes. Addressing these challenges requires a concerted effort to standardise care pathways, implement evidence-based interventions, and promote equitable access to high-quality care. Future research should prioritise the development and validation of robust frameworks to identify unwarranted variations and assess the effectiveness of targeted interventions. Moreover, collaborative, cross-sectoral efforts will be essential to ensure that CRC care systems are patient-centred, equitable, and sustainable. Only through such comprehensive approaches can the healthcare system hope to reduce disparities and improve outcomes for all individuals affected by CRC.

Table 1. Search Strategy

Search #	Limits English, Journal Article, Humans, Publication Date from 2018
1.	((rectal or rectum) adj3 (neoplas* or cancer* or malignan* or metastat* or tumo?r*)).ti,ab,kf.
2.	(bowel adj3 (neoplas* or cancer* or malignan* or metastat* or tumo?r*)).ti,ab,kf.
3.	((colorectal or colon) adj3 (neoplas* or cancer* or malignan* or metastat* or tumo?r*)).ti,ab,kf.
4.	colorectal neoplasms/ or colonic neoplasms/ or colorectal neoplasms, hereditary nonpolyposis/ or rectal neoplasms/
5.	1 or 2 or 3 or 4
6.	Practice Guidelines as Topic/
7.	"Delivery of Health Care"/
8.	Health Services Accessibility/
9.	Evidence-Based Practice/
10.	(quality adj3 (health care or healthcare or improvement* or "indicator* of health")).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]
11.	(quality adj3 (health care or healthcare or improvement* or "indicator* of health")).ti,ab,kf.
12.	6 or 7 or 8 or 9 or 11
13.	evidence based practice.mp.

14.	optimal care.mp.
15.	Treatment Outcome/
16.	treatment outcome.ti,ab,kf.
17.	(variance or variation* or unwarranted varia* or warranted varia*).mp.
18.	13 or 14 or 15 or 16 or 17
19.	limit 17 to (english language and yr="2018 -Current")
20.	5 and 12 and 18 and 19

Table 2. Summary of the evidence base – colorectal cancer (N=82)

First author	Year	Country	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Abboud Y [61]	2024	United States	Step 1: Prevention and early detection	Retrospective	To analyse time trends in EO-CRC incidence rates across various US regions and to assess these trends by sex and histopathological subtypes (ADC and NET).	514,875 individuals aged 20–54 years were diagnosed with early-onset CRC	Between 2001 and 2020, a total of 514,875 individuals were diagnosed with early-onset CRC in the US, with 54.78% being men. Incidence rates and trends varied across geographical regions. In the western region (comprising 106,685 patients, 54.85% men), incidence rates significantly increased in both women (average annual percentage change (AAPC) = 1.37, $p < 0.001$) and men (AAPC = 1.34, $p < 0.001$). Similarly, in the mid-western region (with 110,380 patients, 55.46% men), there were significant increases in incidence rates among women (AAPC = 1.06, $p < 0.001$) and men (AAPC = 1.35, $p < 0.001$). The northeastern region (with 94,758 patients, 54.53% men) also witnessed significant increases in incidence rates for both women (AAPC = 0.71, $p < 0.001$) and men (AAPC = 0.84, $p < 0.001$). In contrast, the southern region (with 203,052 patients, 54.48% men) experienced slower increases in incidence rates among both women and men (AAPC = 0.25, $p < 0.05$ in women; AAPC = 0.66, $p < 0.05$ in men). When stratified by histopathology, incidence rates for adenocarcinomas (ADC) increased in all regions, most notably in the west (AAPC = 1.45, $p < 0.05$), and least in the south (AAPC = 0.46, $p < 0.05$). Conversely, for neuroendocrine tumours (NET), while incidence rates increased similarly across all regions, the pace was notably faster compared to ADC, particularly in the west (AAPC = 3.26, $p < 0.05$) and slower in the south (AAPC = 2.24, $p < 0.05$).	The most substantial increases in incidence rates were observed in the west, while the least pronounced changes were noted in the south, affecting both men and women. These trends persisted across the main CRC histopathological subtypes, with NET exhibiting a notably swifter pace of increase compared with ADC. These findings hold important implications for public health strategies and underscore the need for targeted interventions to address the rising burden of early-onset CRC across different regions in the US.
Araghi M [41]	2021	International (Australia, Canada, Denmark, France, Ireland, New Zealand, Norway, UK)	Step 3: Diagnosis, staging and treatment planning	Retrospective	As part of the International Cancer Benchmarking Partnership (ICBP) SURVMARK-2 project, the objective of this article is to provide the most recent estimates of colon and rectal cancer survival in seven high-income countries by age and stage at diagnosis.	405 255 patients with colon and rectal cancer (colon cancer: 294 996; rectal cancer: 110 259) diagnosed during 2010–2014	(One-year) and 5-year net survival varied between (77.1% and 87.5%) 59.1% and 70.9% and (84.8% and 90.0%) 61.6% and 70.9% for colon and rectal cancer, respectively. Survival was consistently higher in Australia, Canada and Norway, with smaller proportions of patients with metastatic disease in Canada and Australia. International differences in (1-year) and 5-year survival were most pronounced for regional and distant colon cancer ranging between (86.0% and 94.1%) 62.5% and 77.5% and (40.7% and 56.4%) 8.0% and 17.3%, respectively. Similar patterns were observed for rectal cancer. Stage distribution of colon and rectal cancers by age varied across countries with marked survival differences for patients with metastatic disease and diagnosed at older ages (irrespective of stage).	Survival disparities for colon and rectal cancer across high-income countries are likely explained by earlier diagnosis in some countries and differences in treatment for regional and distant disease, as well as older age at diagnosis. Differences in cancer registration practice and different staging systems across countries may have impacted the comparisons.
Aranda E [50]	2020	Spain	Step 4: Treatment	Retrospective, observational, multicentre study	To describe the treatment patterns according to the type of treatment received by patients with metastatic colorectal cancer (mCRC) in Spain.	873	At the time of inclusion, of the 873 evaluable patients, 507 (58%) had received two lines, 235 (27%) had received three lines, 106 (12%) had received four lines, and the remaining patients had received up to ten lines. The most frequent chemotherapy schemes were the FOLFOX or CAPOX regimens (66%) for first-line treatment, FOLFOX, CAPOX or FOLFIRI (70%) for second-line treatment, and FOLFOX, FOLFIRI or other fluoropyrimidine-based regimens for third- and fourth-line (over 60%) treatment. Sixty percent of patients received targeted therapy as part of their first-line treatment, and this proportion increased up to approximately 70% of patients as part of the second-line of treatment. A relevant proportion of patients were treated with unknown KRAS, and especially the BRAF, mutation statuses.	This study reveals inconsistencies regarding adherence to the recommendations of the European Society for Medical oncology (ESMO) guidelines for the management of mCRC in Spain. Improved adherence to the standard practice described in such guidelines for the determination of RAS and BRAF mutation statuses and the use of targeted therapies in first-line treatment should be considered to guarantee that patients can benefit from the best therapeutic approaches available.

First author	Year	Country	OCF Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Baltussen JC [51]	2023	The Netherlands	Step 4: Treatment	Nationwide population-based cohort	To investigate time trends in treatment patterns and overall survival of Dutch older patients with synchronous metastatic colorectal cancer, diagnosed between 2005 and 2020.	22 192	Results showed that chemotherapy use increased between 2005 and 2015, but declined from 2015 onwards, while more patients received best supportive care. Over time, fewer patients underwent primary tumour resection alone. Although survival of both metastatic colon and rectal cancer improved until 2014, survival of colon cancer decreased from 2014 onwards (HR 1.04, 95% confidence interval [CI] 1.01-1.05), which was seen in all age groups. Survival of metastatic rectal cancer patients remained unchanged from 2014 onwards (HR 1.00, 95% CI 0.98-1.03) in all age groups.	Treatment patterns of Dutch older patients with synchronous metastatic colorectal cancer rapidly changed from 2005 to 2020, with increasing percentages of patients receiving best supportive care. Survival of metastatic colon cancer decreased from 2014 onwards. The implementation of a colorectal cancer screening program and patient selection might explain why only a subset of older patients seem to benefit from the availability of novel treatment options.
Baum S [62]	2023	Australia	Step 1: Prevention and early detection	Ecological analysis	To explore the socio-demographic and spatial patterns of screening participation across Australian regions to better inform public health policy and programs.		The global regression results show that higher rates of screening participation were associated with employment / education disengagement and volunteering while in contrast, lower rates of participation were associated with higher rates of indigenous populations, people with chronic health conditions, and people with poor English skills. Considering the spatial analysis, the analysis shows that once the spatial non-stationarity in the data is considered the influence of the variables shown to be significant in the global model, has significant spatial variability.	From a public health perspective, addressing shortfalls in bowel cancer screening participation is an important priority. To understand differences in participation rates it is important to consider both socio-demographic factors as well as the geographic or spatial distribution of these factors.
Bergin RJ [42]	2020	Australia	Step 4: Treatment	Cross-sectional survey	To examine concordance between OCP recommendations and colorectal cancer care prior to policy rollout and disparities for vulnerable populations.	433 patients, 290 GPs and 144 specialists	Use of recommended GP investigations varied from 66% for colonoscopy to 13% for digital rectal exam. Recommended waiting times to receive a colonoscopy, see a specialist after referral, and begin adjuvant chemotherapy were exceeded for around a third of patients. Twenty-eight percent of specialists reported a pre-treatment multidisciplinary meeting. Most patients received surgery in a hospital with an intensive care unit (92%) and chemotherapy for high-risk disease (84%). In general, care was similar across sociodemographic groups. However, receipt of GP investigations tended to be higher and waiting times longer for rural, low socio- economic, and non-privately insured patients. For example, receiving a colonoscopy within 4 weeks was significantly less likely for rural (51%) than urban (78%) patients (odds ratio = 0.30; 95% confidence interval, 0.11-0.79).	Prior to implementation, a significant proportion of colorectal cancer patients received care that did not meet OCP recommendations. Low concordance and inequities for rural and disadvantaged populations highlight components of the pathway to target during policy implementation.
Boehmer U [98]	2020	United States	Step 5: Care after initial treatment and recovery	Questionnaire	To assess sexual minority and heterosexual survivors' perceived quality of cancer care and identify demographic, clinical, and psychosocial characteristics associated with patient-centred quality of care.	480	Sexual minority survivors rated physician communication, nursing care, and coordination of care similarly to heterosexual survivors, yet a significantly higher percentage of sexual minority survivors rated the overall quality of their cancer care as excellent (59% vs. 49%). Sexual minority survivors' greater likelihood of reporting excellent care remained unchanged after adjusting for demographic, clinical, and psychosocial characteristics.	Sexual minority survivors' ratings of quality of colorectal cancer care were comparable or even higher than heterosexual survivors. Sexual minority survivors' reports of excellent care were not explained by their interpersonal care experiences.
Boyle J [99]	2020	United Kingdom	Step 4: Treatment	Retrospective using linked datasets	To explore determinants of adjuvant chemotherapy (ACT) use and between hospital variation within the English National Health Service.	11,932 patients (diagnosed 2014-2017)	60.7% of patients received ACT. Age was the strongest determinant. Compared to patients <60 years, those aged 60-64 (adjusted odds ratio (aOR) 0.76 (95% CI 0.63-0.93), 65-69 (aOR 0.63 (0.54-0.74)), 70-74 (aOR 0.53 (95% CI 0.44-0.62)), 75-79 (aOR 0.23 (0.19-0.27)) and ≥80 (aOR 0.05 (0.04-0.06)) were significantly less likely to receive ACT. With adjustment for other factors, ACT use was more likely in patients with higher socioeconomic status, fewer comorbidities, better performance status, lower ASA grade, advanced disease, elective resections, laparoscopic procedures, and no unplanned readmissions. Hospital-level	There is significant between-hospital variation in ACT use for stage III colon cancer, especially for older patients. Advanced age alone seems to be a greater barrier to ACT use in some hospitals.

First author	Year	Country	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
							factors were non-significant. The observed proportions of ACT administration in the young and elderly were 46%-100% (80% hospitals 74%-90%) and 10%-81% (80% hospitals 33%-65%) respectively. Risk-adjustment did not reduce between-hospital variation. Despite adjustment, age accounted for 9.9% (7.2%-13.4%) of between-hospital variation in the elderly compared to 2.7% (1.2%-5.7%) in the young.	
Buchheit JT [43]	2024	United States	Step 4: Treatment	Retrospective	To compare disparities in care delivery and outcomes at low- and high-performing hospitals.	92,573	Of 92,573 patients from 704 hospitals, 45,982 (49.7%) were treated at 404 low-performing hospitals and 46,591 (50.3%) were treated at 300 high-performing hospitals. Low-performing hospitals treated more non-Hispanic (NH) Black, Hispanic, low SES, and Medicaid patients (all $p < 0.01$). Among low-performing hospitals, patients with low versus high SES (odds ratio [OR] 0.87, 95% confidence interval [CI] 0.82–0.92), and Medicare (OR 0.90, 95% CI 0.85–0.96) and Medicaid (OR 0.88, 95% CI 0.80–0.96) versus private insurance, had decreased odds of receiving high-quality care. At high-performing hospitals, NH Black versus NH White patients (OR 0.83, 95% CI 0.72–0.95) had decreased odds of receiving high-quality care. Low SES, Medicare, Medicaid, and uninsured patients had worse overall survival at low- and high-performing hospitals (all $p < 0.01$).	Disparities in receipt of high-quality colon cancer care occurred by SES and insurance at low-performing hospitals, and by race at high-performing hospitals. However, survival disparities by SES and insurance exist irrespective of hospital performance. Future steps include improving low-performing hospitals and identifying mechanisms affecting survival disparities.
Burnett-Hartman AN [56]	2019	United States	Step 4: Treatment	Case–case comparison study	To describe differences in treatment patterns and survival between early onset (< 50 years old) and late-onset colorectal cancer (CRC) patients in community-based health systems.	12,234	Compared to late-onset CRC, early-onset CRC was significantly associated with advanced-stage disease, high-grade histology, signet ring histology, and rectal or left colon location. After adjusting for differences in tumour and patient characteristics, early-onset patients were more likely than late-onset patients to have > 12 lymph nodes examined (OR 1.60, CI 1.37–1.87), to receive systemic therapy (chemotherapy or immunotherapy) within 6 months of diagnosis (OR 2.84, CI 2.40–3.37), and to have a reduced risk of CRC-specific death (HR 0.66, CI 0.56–0.79).	Early-onset CRC is associated with aggressive tumour characteristics, distal location, and systemic therapy use. Despite some adverse risk factors, these patients tend to have better survival than older onset patients.
Burr NE [100]	2019	United Kingdom	Step 5: Care after initial treatment and recovery	Population based cohort study	To quantify post-colonoscopy colorectal cancer (PCCRC) rates in England by using recent World Endoscopy Organisation guidelines, compare incidence among colonoscopy providers, and explore associated factors that could benefit from quality improvement initiatives.	121 402	The overall unadjusted PCCRC-3yr rate was 7.4% (9317/126152), which decreased from 9.0% in 2005 to 6.5% in 2013 ($P < 0.01$). Rates were lower for colonoscopies performed under the NHS bowel cancer screening program (593/16640, 3.6%), while they were higher for those conducted by non-NHS providers (187/2009, 9.3%). Rates were higher in women, in older age groups, and in people with inflammatory bowel disease or diverticular disease, in those with higher comorbidity scores, and in people with previous cancers. Substantial variation in rates among colonoscopy providers remained after adjustment for case mix.	Wide variation exists in PCCRC-3yr rates across national health service (NHS) colonoscopy providers in England. The lowest incidence was seen in colonoscopies performed under the NHS bowel cancer screening programme. Quality improvement initiatives are needed to address this variation in rates and prevent colorectal cancer by enabling earlier diagnosis, removing premalignant polyps, and therefore improving outcomes.
Byrne H [75]	2021	United Kingdom	Step 4: Treatment	Online survey	To compare surgeons' practice for the provision of colorectal (CR) cancer surgery across the United Kingdom (UK), against updated Joint Royal Colleges & Association of Coloproctology of Great Britain and Ireland (ACPGBI) guidelines and highlight differences in practice, if any.	29	29 individual responses were received from 23 NHS Trusts across the UK. 23/29 (79%) surgeons ceased or experienced delays in their CR cancer surgeries during the pandemic, with 3/29 (10%) yet to reintroduce these services. 19/26 (73%) surgeons instructed their patients to self-isolate prior to surgery, of which 5/19 (26%) correctly enforced a duration of 14 days. 10/19 (53%) participants adhered to guidelines of performing a CT chest within 24 h of surgery. 10/26 (38%) participants believe their patients are experiencing longer hospital admissions in the COVID-19 setting.	This snapshot survey highlights the dramatic variations in CR cancer surgery practice within the UK and inconsistent adherence to protocols. Guidelines will no doubt change as our knowledge of COVID-19 increases both nationally and internationally. It is essential CR surgeons keep up to date with changes in guidance, so uniformity in practice can be maintained.

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Calderwood AH [76]	2021	United States	Step 2: Presentation, initial investigations and referral	Retrospective	To quantify the impact of the pandemic on endoscopy volumes and indications in the United States.	451 practices with 3,514 contributing endoscopists	Among 451 sites with 3514 endoscopists, the average monthly volume of colonoscopies and EGDs dropped by 38.5% and 33.4%, respectively. There was regional variation, with the greatest and least decline in procedures in the Northeast and South, respectively. There was a modest shift in procedure indications from prevention to diagnostic, an initial increase in performance in the hospital setting, and a decrease in procedures with trainees. The decline in volume of colonoscopy and EGD during the first 7 months of the pandemic was equivalent to approximately 2.7 and 2.4 months of pre-pandemic productivity, respectively. Thirty percent fewer colorectal cancers were diagnosed compared to expected.	The data on actual endoscopy utilisation nationally during the pandemic can help in anticipating impact of delays in care on outcomes and planning for the recovery phase.
Campbell C [69]	2020	Scotland, United Kingdom	Step 1: Prevention and early detection	Retrospective	To describe bowel cancer screening uptake rates in detail by self-reported ethnic group, including White Scottish, other white British, white Irish, other White, Indian, Pakistani, Bangladeshi, other South Asian, Caribbean, African Other Black, Chinese, in addition to self-reported religious affiliation	1 666 575 (round 1); 1, 1 407 835 (round 2)	In the first, incidence screening round, compared with white Scottish men, Other White British (RR 109.6, 95%CI 108.8 to 110.3) and Chinese (107.2, 95% CI 102.8 to 111.8) men had higher uptake. In contrast, men of all South Asian groups had lower uptake (Indian RR 80.5, 95% CI 76.1 to 85.1; Pakistani RR 65.9, 95% CI 62.7 to 69.3; Bangladeshi RR 76.6, 95% CI 63.9 to 91.9; Other South Asian RR 88.6, 95% CI 81.8 to 96.1). Comparable patterns were seen among women in all ethnic groups, for example, Pakistani (RR 55.5, 95% CI 52.5 to 58.8). Variation in uptake was also observed by religion, with lower rates among Hindu (RR (95%CI): 78.4 (71.8 to 85.6)), Muslim (69.5 (66.7 to 72.3)) and Sikh (73.4 (67.1 to 80.3)) men compared with the reference population (Church of Scotland), with similar variation among women: lower rates were also seen among those who reported being Jewish, Roman Catholic or with no religion.	There are important variations in uptake of bowel cancer screening by ethnic group and religion in Scotland, for both sexes, that require further research and targeted interventions.
Castañeda-Avila MA [70]	2021	United States	Step 1: Prevention and early detection	Cross-sectional	To assess current estimates of colorectal cancer (CRC) screening practices in relation to cardiovascular disease (CVD) status and whether this association varies by race/ethnicity.	807937	One-quarter of US adults had never been screened for CRC, while 67.0% reported being up to date with CRC screening. The proportion of Hispanics who had never been screened (35.3%) was higher than non-Hispanic Whites (23.5%) and Blacks (20.6%). Adults with CVD were less likely to never have been screened (adjusted odds ratio (aOR), 0.92; 95% confidence interval (CI), 0.88–0.95) or not to be up-to-date (aOR, 0.90; 95% CI, 0.86–0.94) on CRC screening than those without CVD.	The presence of CVD is associated with better adherence to CRC screening guidelines. Poor CRC screening utilisation in Hispanics should be a priority for further investigation and intervention.
Cayuela L [119]	2024	Spain	Step 1: Prevention and early detection	Ecological trend study	To evaluate how age, period, and cohort (A-P-C) impact CRC incidence in Spain from 1990 to 2019.	1,010,186 cases	CRC incidence increased steadily in Spain from 1990 to 2019, with a more significant rise in men than in women. The age standardised rates rose from 84.9 to 129.3 cases per 100,000 in men and from 56.9 to 70.3 cases per 100,000 in women. Joinpoint analysis revealed distinct patterns for men and women: men's incidence showed three phases--a surge until 1995, a slowdown until 2012, and a subsequent decrease--while women's incidence experienced a single increase until 2011 and then stabilised. Local drifts increased in all age groups over 45, with stability in men under 45 and a decrease in women aged 30-39. The risk of CRC increased with age, with men consistently having a higher risk than women. The risk of CRC increased over time for both men and women but at different rates. The risk for cohorts born in the early to mid-20th century peaked in the 1960s and remained stable until the late 1990s.	The increasing incidence of CRC in Spain, with distinct patterns by gender and birth cohort, underlines the importance of preventive strategies adapted to temporal and demographic variations to address this public health challenge.
Chan, WP [101]	2021	Singapore	No OCP step: General - surveillance	Survey	To explore the preferred method of CRC surveillance, rate of random biopsies during surveillance,	The survey was completed by 265 physicians from 34 countries, of whom	There were 217 eligible responses, with most gastroenterologists working in public hospitals (76%) and treating >10 patients with IBD weekly (71%). High-definition white light endoscopy (HDWLE) was available in 93.1% of the	The preferred method of CRC surveillance was HDWLE with chromoendoscopy and targeted biopsies. Random biopsies were

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					and practice of managing dysplastic lesions in IBD of the gastroenterologists globally in order to determine to what extent the practice of CRC surveillance and management of dysplasia differed among physicians from Asia and Western countries.	217 gastroenterologists met the enrolment criteria	centres. The preferred mode of surveillance was HDWLE with dye-spray chromoendoscopy and targeted biopsies (41.2%). Fewer than 50% of physicians reported using chromoendoscopy in >50% of cases, citing time as the limiting factor (73.7%). Of these gastroenterologists 63% infrequently (<25% of cases) performed random biopsies during chromoendoscopy. They would attempt endoscopic mucosal resection for polypoid lesions >10 mm (67.2%), including >20 mm lesions with low grade dysplasia (49.8%), and non-polypoid lesions >10 mm without dysplasia (56.9%). For non-polypoid lesions >20 mm with low- and high-grade dysplasia, referral to expert endoscopists was the preferred option.	infrequently performed. The uptake of chromoendoscopy for surveillance in practice was low. Physicians varied in their approach in removing endoscopically resectable dysplastic lesions.
Chodoff A [80]	2022	United States	Step 5: Care after initial treatment and recovery	Content analysis of supportive care plans (SCPs)	To describe SCP completeness and comparing surveillance recommendations on the plans with clinical practice guidelines.	74	SCP information provided in >80% of the plans included participant age, cancer diagnosis, details, and side-effects of treatment (surgery, chemotherapy, radiation) and health promotion recommendations. SCP content documented less frequently included predisposing conditions, genetic counselling/testing information and staging. Posttreatment surveillance recommendations were documented in >90% SCPs. For stage 2–3 cancer, rates of guideline concordant recommendations were 100% for colonoscopy surveillance (Year 1 only), 87% for imaging surveillance, 65% for carcinoembryonic antigen surveillance, and 33% for follow-up visits. Excluding colonoscopy, >15 unique recommendations were listed for each modality across stages and sites, with more variation at the academic site.	SCPs consistently recorded information about cancer diagnosis and treatment but omitted critical information about cancer-specific details denoting risk. Surveillance recommendations varied considerably between cancer centres. Future work to improve the consistency of surveillance recommendations documented in SCPs may be needed.
Clark GR [71]	2023	United Kingdom	Step 1: Prevention and early detection	Retrospective	To investigate the effect of a national faecal haemoglobin (f-Hb)-based CRC screening programme on population CRC-specific mortality and to assess if any effects are associated with sex and differ between men and women.	Not reported only aged standardised rates	CRC mortality declined from 1990 to 2020, but not linearly, and differed between sexes. In women, 1990–99 showed a steady decline [average annual percentage change (AAPC): 2.1%, 95% confidence interval (CI): 2.8% to 1.4%], but a less marked decline after 2000 (AAPC: 0.7%, 95% CI: 0.9% to 0.4%). In men, no clear decline was seen from 1990 to 1999 (AAPC: 0.4%, 95% CI: 1.1% to 0.4%), but mortality declined from 2000 to 2020 (AAPC: 1.7%, 95% CI: 1.9% to 1.5%). This pattern was exaggerated in the screening age ranges. For 2000–20, the overall reduction in mortality was less in women and in the screening age range. In the post-screening age range, reductions were smaller, but an increase was seen in the pre-screening age range, greater in women.	CRC mortality fell during 1990–2020, but the decline differed markedly between sexes, indicating a larger beneficial effect of screening on CRC mortality in men compared to women: use of different thresholds for the sexes might lead to equality.
Colibaseanu DT [84]	2018	United States	Step 7: End-of-life care	Retrospective	To determine the factors associated with palliative care use among patients who died of colorectal cancer.	287923	Overall, 4.3% of the patients received palliative care. Patients who received palliative care were more likely to be younger, recently diagnosed, treated at academic hospitals, and have stage IV disease. Patients living in Mountain and Pacific regions had higher odds of palliative care receipt than those in the East Coast. Patients without insurance had higher odds of palliative care if they survived <24 months. Insurance coverage through Medicaid was associated with increased palliative care use among patients who survived 6 to 24 months. Patients who survived <6 months and lived >9 miles from the institution received more palliative care.	Palliative care use among patients with colorectal cancer is associated with a younger age, a more recent year of diagnosis, insurance status, academic hospitals, and living in Mountain and Pacific regions.
da Silva Nascimento ML [102]	2024	Brazil	Step 3: Diagnosis, staging and treatment planning	Retrospective cohort study	To compare the BC of patients with CRC, specifically considering the site of the primary tumour (colon or rectum) and the	635	A total of 635 individuals were evaluated, with a mean age of 61.8± 12.4 years and 50.2% female. The majority had rectal cancer as the primary cancer site (51.0%), and 23.6% had metastatic disease. The first regression model showed tumour site and metastasis as independent factors influencing skeletal muscle (SM), skeletal muscle index (SMI), and	Findings highlight significant BC variations in patients with CRC, influenced by tumour location and metastases presence, underscoring the need for location-specific assessment in CRC management.

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					presence or absence of metastases.		visceral adipose tissue variability (all p values < 0.05). The second model, adjusted for BMI, indicated tumour site as the primary factor affecting SMI variations (adjusted R ² = 0.50 p < 0.001), with colon tumours inversely associated with SM (standardised β -2.15(- 3.3;- 0.9) p < 0.001). A third model, considering all the confounders from the directed acyclic graphs, was constructed and the found association remained independent	
Dagne GA [63]	2022	United States	Step 1: Prevention and early detection	Retrospective	To identify county-level risk factors that may be associated with the incidence of CRC and to map hotspots for CRC in Florida.	174 cases	The county-level unadjusted incidence rates range from .462 to 3.142. After fitting a Bayesian spatial model to the data, the results show that a decreasing risk of CRC is strongly associated with an increasing median income, higher percentage of Black population, and higher percentage of sedentary life at county level. Using exceedance probability, it is also observed that there are clustering and hotspots of high CRC incidence rates in Charlotte County in South Florida, Hernando, Sumter and Seminole counties in central Florida and Union and Washington counties in north Florida.	Among few county-level variables that significantly explained the spatial variation of CRC, income disparity may need more attention for resource allocation and developing preventive intervention in high-risk areas for CRC.
Darvishian M [73]	2023	Canada	Step 1: Prevention and early detection	Retrospective	To evaluate regional variation in screening uptake, identify contributing factors to non-adherence to CRC screening, and estimate the adherence to CRC screening among individuals with different risk profiles.	261760	Adherence to CRC screening varied considerably between regions, ranging from 16.6% in CARTaGENE to 47.7% in OHS. Compared to the largest cohort OHS, the likelihood of non-adherence to CRC screening was significantly higher in BCGP (OR 1.15, 95% CI 1.11-1.19), the Atlantic PATH (OR 1.90, 95% CI 1.82-1.99) and CARTaGENE (OR 5.10, 95% CI 4.85-5.36). Low physical activity, current smoking, presence of personal risk, family history of CRC significantly reduced the likelihood of adherence to screening recommendations.	Compared to the national target of ≥ 60% for participation in CRC screening, adherence to regular CRC screening was suboptimal in this cohort of Canadians and varied by region. Further efforts are needed to identify the specific barriers to screening adherence in different provinces and across risk categories.
Dasgupta P [131]	2023	Australia	Step 1: Prevention and early detection	Retrospective	To describe small-area and broad geographical patterns in bowel screening participation in Australia between 2015–2020.	Participation in the NBCSP increased from 1,294,442 people in 2015–2016 to 2,522,177 people during 2019–2020.	Overall, screening participation rates was around 44% over the three time-periods. Participation was consistently lower in remote or disadvantaged areas, although heterogeneity was evident within these broad categories. There was strong evidence of spatial differences in participation over all three periods, with little change in patterns between time periods. If the spatial variation was reduced (so low participation areas were increased to the 80th centile), an extra 250,000 screens (4% of total) would have been conducted during 2019–2020.	Despite having a well-structured evidence-based government funded national bowel cancer screening program, the substantial spatial variation in participation rates highlights the importance of accounting for the unique characteristics of specific geographical regions and their inhabitants. Identifying the reasons for geographical disparities could inform interventions to achieve more equitable access and a higher overall bowel screening uptake.
Dinger TL [120]	2022	Australia and New Zealand (ANZ)	Step 4: Treatment	Prospective	To explore regional variance in treatment and outcomes of patients with locally advanced rectal cancer in Australia and New Zealand.	9385	A total of 9385 patients with rectal cancer were identified, with an overall circumferential resection margin (CRM)+ rate of 6.4% and circumferential and/or distal resection margin (CRM/DRM)+ rate of 8.6%. There were 1350 patients with T4 rectal cancer (14.4%). For these patients, CRM+ rate was 18.5%, and CRM/DRM+ rate was 24.1%. Significant regional variation in CRM+ (range 13.4–26.0%; p = 0.025) and CRM/DRM+ rates (range 16.1–29.3%; p = 0.005) was identified. In addition, regions with higher CRM+ and CRM/DRM+ rates reported lower rates of multi-visceral resections: range 24.3–26.8%, versus 32.6 37.3% for regions with lower CRM+ and CRM/DRM+ rates (p < 0.0001).	Positive resection margins and rates of multi-visceral resection vary between the different regions of ANZ. A small subset of patients with T4 rectal cancer are particularly at risk, further supporting the concept of referral to specialised exenteration centres for potentially curative multi-visceral resection.
Dong W [44]	2023	United States	Step 1: Prevention and early detection	Cross-sectional	To uncover geographic disparities in early onset colorectal cancer (EOCRC) and understand how risk factors between	136,065 (early-onset CRC) and 1,141,775 (late-onset CRC)	The geospatial analysis revealed large geographic variations in EO CRC and LO CRC incidence rates. For example, some regions had relatively low late-onset of colorectal cancer (LO CRC) and high EO CRC rates (e.g., Georgia and eastern Texas) while others had relatively high LO CRC and low	This community-level analysis demonstrates the geographic variation in EO CRC burden and the distinctive set of risk factors most predictive of EO CRC.

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					EOCRC and LOCRC differ.		EOCRC rates (e.g., Iowa and New Jersey). The random forest analysis revealed that the importance of community-level risk factors most predictive of EOCRC versus LOCRC incidence rates differed meaningfully. For example, diabetes prevalence was the most important risk factor in predicting EOCRC incidence rate, but it was a less important risk factor of LOCRC incidence rate; physical inactivity was the most important risk factor in predicting LOCRC incidence rate, but it was the fourth most important predictor for EOCRC incidence rate.	
Emery J [74]	2023	Australia	Step 1: Prevention and early detection	Randomised control trial	To determine the effect of a consultation in general practice using a computerised risk assessment and decision support tool (Colorectal cancer RiSk Prediction, CRISP) on risk-appropriate CRC screening.	734	A total of 734 participants (65.1% of eligible patients) were randomised (369 intervention, 365 control); the primary outcome was determined for 722 (362 intervention, 360 control). There was a 6.5% absolute increase (95% confidence interval [CI]=−0.28 to 13.2) in risk-appropriate screening in the intervention compared with the control group (71.5% versus 65.0%; odds ratio [OR] 1.36, 95% CI=0.99 to 1.86, P=0.057). In those due CRC screening during follow-up, there was a 20.3% (95%CI=10.3 to 30.4) increase (intervention 59.8% versus control 38.9%; OR2.31, 95% CI=1.51 to 3.53, P<0.001) principally by increasing faecal occult blood testing in those at average risk.	A risk assessment and decision support tool increases risk-appropriate CRC screening in those due screening. The CRISP intervention could commence in people in their fifth decade to ensure people start CRC screening at the optimal age with the most cost-effective test.
Farooq A [103]	2022	Canada	Step 2: Presentation, initial investigations and referral	Case control study	To evaluate patterns of healthcare utilisation before diagnosis of young-onset colorectal cancer (yCRC)	2567	The researchers observed an increasing number of outpatient visits from pre-diagnosis year-5 (median = 3) to year-1 (median = 8) for yCRC cases. Among controls, outpatient visits were stable and did not have a pattern of increase. Poisson regression models indicated higher adjusted count ratios for outpatient visits for yCRC cases compared to controls in the year before diagnosis (1.11; 95% CI, 1.07 to 1.15). In the year before diagnosis, 35.1% of yCRC cases had potentially related visits to CRC (e.g., nausea, vomiting) and 16.9% had potentially red flag visits (e.g., gastrointestinal haemorrhage or iron deficiency anaemia).	Using population-based data, the researchers found that individuals with yCRC did not have higher healthcare utilisation than individuals without in the prediagnosis period except for the year before diagnosis.
Finke I [132]	2021	Finland	Step 6: Managing recurrent, residual or metastatic disease	Register-based observational study	To investigate the impact of education on CRC survival by using both individual and area-based information on education.	24462	There was a clear gradient in 5-year relative survival across education groups (men: basic 62%, secondary 64%, high 69%; women: basic 61 %, secondary 67%, high 71%). Compared to the basic education group, RER in the high education group was significantly lower. This association was still present after including area-based education in the models (men: RER 0.72, 95% Confidence interval (CI) 0.64–0.81; women: RER 0.76, 95% CI 0.59–0.96). Area-based education revealed smaller effect estimates than individual education in CRC survival and no association for men.	Key findings: <ul style="list-style-type: none"> • Lower individual education was associated with lower colorectal cancer survival. • Area-based education had less impact on colorectal cancer survival differences. • Effects of education on survival were generally stronger in women than men. • The association could not be explained by regional variation. • Stage at diagnosis explained a small part of the effect of education on survival.
Fitzdam S [104]	2021	Australia	Step 4: Treatment	Population-based, retrospective cohort	To investigate demographic, clinical and access factors associated with lung, breast and bowel cancer treatment for Aboriginal people compared with non-Aboriginal people in New South Wales, Australia.	587 Aboriginal and 34 015 non-Aboriginal people	There were no significant differences in cancer treatment for Aboriginal people compared with non-Aboriginal people for breast or bowel cancers after adjusting for patient sex, age, disease extent and comorbidities.	The focus for breast and bowel cancers should be on prevention, screening and earlier diagnosis for Aboriginal people, who were diagnosed with more advanced disease than their non-Aboriginal counterparts, similar to findings from other studies.8,11,13,34 Participation by Aboriginal people in the

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								national bowel screening programme is estimated to be half that of non-Aboriginal people (21% vs 43%)
Franklyn J [64]	2023	United Kingdom	Step 6: Managing recurrent, residual or metastatic disease	Population-based retrospective study	To assess the long-term colorectal cancer outcomes in different geographical regions in England using population data between the years 2010 and 2014.	167501	Regions in the southern England had better outcomes with Southwest and Oxford registries having 63.5 and 62.7% 5-year relative survival. In contrast, Trent and Northwest cancer registries had 58.1% relative survival ($p < 0.01$). The regions in the north fared below the national average. The survival outcomes reflected socio-economic deprivation status, the best performing regions in the south having low levels of deprivation (5.3 and 6.5% having maximum deprivation in Southwest and Oxford, respectively). The regions with worst long term cancer outcomes had high levels of deprivation with 25% and 17% having high levels of deprivation in Northwest and Trent regions.	There are significant variations in long term colorectal cancer survival between different regions in England, southern England had better relative survival when compared with the northern regions. Disparities in socio-economic deprivation status in different regions may be associated with worse colorectal cancer outcomes.
Fwelo P [105]	2023	United States	Step 4: Treatment	Retrospective cohort study	To examine the associations of socioeconomic status (SES), race/ethnicity, surgery type, and treatment delays with mortality among colon cancer patients. In addition, the study also quantifies the extent to which clinical and SES factors' variations explain the racial/ethnic differences in overall survival.	111789	Non-Hispanic (NH) Blacks [adjusted Odds Ratio (aOR) = 1.19, 95% CI: 1.13–1.25] were significantly more likely to undergo subtotal colectomy and to experience treatment delays [aOR = 1.39, 95% CI: 1.31–1.48] compared to NH Whites. Hispanics [aOR = 1.59, 95% CI: 1.49–1.69] were more likely to experience treatment delays than NH Whites. Delayed first course of treatment explained 23.56% and 56.73% of the lower survival among NH Blacks and Hispanics, respectively, compared to their NH White counterparts.	Race/ethnicity is significantly associated with the surgery type performed and the first course of treatment delays. Variations in treatment, SES, and clinicopathological factors significantly explained racial disparities in overall mortality. These disparities highlight the need for multidisciplinary interventions to address the treatment and social factors perpetuating racial disparities in colon cancer mortality.
Garwood V [78]	2020	Australia	Step 6: Managing recurrent, residual or metastatic disease	Retrospective cohort study	To determine: (1) what are the patterns of follow-up visits in CRC survivors in the first three years post-treatment, compared to the frequency recommended by guidelines; and (2) to what extent is the documented content of these visits concordant with recommended guidelines?	206	Forty-eight survivors comprised the study population, 34 of whom (71%) attended the recommended two to four follow-up visits in their first year. Visit notes documented new symptoms (96%), physical changes (85%), physical examination (63%), and investigations (56%–90%); none had documented discussions of screening for other primary cancers, or regular health checks and/or screening. Each survivor had at least one outpatient letter that was sent to their primary care physician, but responsibilities were not adequately defined (31%).	Although survivors regularly attended visits in their first year of follow up in line with recommended guidelines, documentation was inconsistent across many aspects of survivorship care, with many key areas poorly documented. These results contribute to a growing body of evidence that suggests practice has remained focused on detection of disease recurrence and has not adequately expanded to consider the breadth of care as reflected in survivorship care guidelines. Future research should focus on strategies to enable guideline-concordant follow-up care, recognising that oncology specialists require education and training to address the many unmet needs of the cancer survivor.
Ghazali AK [58]	2021	Malaysia	Step 6: Managing recurrent, residual or metastatic disease	Retrospective	To model the spatial variation in survival for colorectal cancer patients in Malaysia, accounting for individual and socioeconomic risk factors.	4412	After controlling for individual and area level characteristics, our findings indicate wide spatial variation in colorectal cancer survival across Malaysia. Better healthcare provision and higher socioeconomic index in the districts where patients live decreased the risk of death from colorectal cancer, but these associations were not statistically significant.	Reliable measurement of environmental factors is needed to provide good insight into the effects of potential risk factors for the disease. For example, a better metric is needed to measure socioeconomic status and accessibility to healthcare in the country. The findings provide new information that might be of use to the Ministry of Health in identifying populations with an

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								increased risk of poor survival, and for planning and providing cancer control services.
Gheybi K [106]	2023	Australia	Step 4: Treatment	Retrospective	To 1) first investigate associations of age and other factors with pattern of care (surgery and chemotherapy) in CRC; and then, 2) to determine how this association varied by comorbidity status and primary cancer site and 3) analyse the extent to which individual comorbidities were associated with different treatments.	8462	The presence of comorbidity was associated with a significantly weaker relationship of age with surgery and chemotherapy. The association of age with surgery also varied for colon and rectal primary cancer sites. Individual comorbidity types varied in their associations with each treatment category. For example, dementia was associated with less chemotherapy provision, however, it was not significantly related to the likelihood of surgery.	This study indicates that the association of age with surgical treatment differed significantly by the CRC subsite. Comorbidity moderated the negative association of age with chemotherapy, and less so, with extent of surgery. Results were novel in indicating associations of multiple individual comorbidity types with CRC treatment modalities. The data suggest that different individual comorbidity types may have different effects on treatment and should be studied separately.
Gigic B [121]	2018	Germany	Step 5: Care after initial treatment and recovery	Longitudinal	To 1) explore dietary behaviour after surgery, 2) to elucidate QoL changes between time before surgery and 12 months post-surgery, and 3) to examine the associations between specific dietary patterns and selected longitudinal QoL changes in CRC patients.	192	Patients following a "Western" diet had lower chances to improve in physical functioning (OR D 0.45 [0.21–0.99]), constipation (OR D 0.30 [0.13–0.72]) and diarrhoea (OR: 0.44 [0.20–0.98]) over time. Patients following a "fruit & vegetable" diet showed improving diarrhoea scores (OR: 2.52 [1.21-5.34]).	"Western" dietary pattern after surgery is inversely associated with QoL in CRC patients, whereas a diet rich in fruits and vegetables may be beneficial for patients' QoL over time.
Gijsbers K [114]	2020	The Netherlands	Step 3: Diagnosis, staging and treatment planning	Online survey	To investigate variations in personal daily practice about T1-CRC among dedicated gastroenterologists and surgeons.	69 returned from 130 physicians	Of the 130 invited physicians, 53% participated. Regarding high-risk T1-CRC criteria, lymphangio-invasion is used by 100%, positive or indeterminable margins by 93%, poor differentiation by 90%, tumour-free margin \leq 1mm by 78%, tumour budding by 57% and submucosal invasion $>$ 1000 μ m by 47%. Fifty-two percent of the respondents do not perform baseline staging in locally resected low-risk T1-CRC. In case of unoperated high-risk patients, the researchers recorded 61 different surveillance strategies in 63 participants, using 19 different combinations of diagnostic tests. Endoscopy is used in all schedules. Mean follow-up time is 36 months for endoscopy, 26 months for rectal MRI and 30 months for abdominal CT (all varying 3–60 months).	The researchers found variable use of pathological high-risk T1-CRC criteria, creating risk for misclassification as low-risk T1-CRC. This has serious implications, as most participants will not proceed to oncological staging in low-risk patients and adjuvant surgery, nor radiological surveillance is considered. On the other hand, oncological surveillance in patients with a locally resected high-risk T1-CRC who do not wish adjuvant surgery is highly variable emphasising the need for a uniform surveillance protocol.
Greijdanus NG [107]	2024	The Netherlands	Step 4: Treatment	Retrospective	To investigate hospital variability in postoperative mortality and anastomotic leakage (AL) after CRC surgery, as well as the association with hospital volume and teaching status.	44101	In the colon cancer (CC) cohort, the unadjusted rates of AL ranged from 2.6 % to 14.4 %, and the unadjusted 90-day mortality rates ranged from 0.0 % to 6.7 %. In the RC cohort, the unadjusted rates of AL ranged from 0.0 % to 28.6 %. After case-mix adjustment, two hospitals performed significantly worse than expected regarding 90-day mortality in the CC cohort, and in both CC and RC cohorts, significant outliers were observed concerning AL. Amongst CC patients, low case volume (OR 1.26 95%CI 1.08–1.46) was significantly associated with AL.	Statistically significant variations in hospital performance were observed among Dutch hospitals after CRC surgery, but this effect could not be entirely attributed to hospitals' teaching status. Nevertheless, concentrating care has the potential to improve outcomes by enhancing individual surgical performance and optimizing care pathways.
Hahn E [88]	2024	United States	Step 1: Prevention and early detection	Mixed-methods	To (1) determine the proportion of patients who repeated faecal testing after an initial positive test rather than proceeding directly to colonoscopy as guidelines	316,443 patients had a positive faecal test	A total of 316,443 patients had a positive faecal test. Within 1 year, 76.3% received a colonoscopy without repeat faecal testing, 3% repeated testing and then received a colonoscopy, 4.4% repeated testing without colonoscopy, and 16.3% did nothing. Among repeat testers (7.4% of total cohort, N = 23,312), 59% did not receive a colonoscopy within 1 year.	Among patients in this cohort, 7.4% repeated faecal testing after an initial positive test. Of those, over half did not go on to receive a colonoscopy within 1 year. Efforts to improve CRC screening must address repeat faecal testing after

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					recommend; (2) evaluate whether the repeat test result pattern (i.e., positive followed by negative vs. positive followed by positive) was associated with failure to complete a colonoscopy after a positive faecal test; and (3) identify patient factors associated with repeat faecal testing compared to the receipt of colonoscopy after a positive test.		In adjusted models, those with an initial positive test followed by a negative second test were significantly less likely to receive colonoscopy than those with two successive positive tests (OR 0.37, 95% CI 0.35–0.40). Older age (65–75 vs. 50–64 years: OR 1.37, 95% CI 1.33–1.41) and higher comorbidity score (≥ 4 vs. 0: OR 1.75, 95% CI 1.67–1.83) were significantly associated with repeat testing compared to those who received colonoscopy without repeat tests. Qualitative interview data revealed reasons underlying repeat testing, including colonoscopy avoidance, bargaining, and disbelief of positive results.	a positive test as a barrier to completing colonoscopy.
Hunger R [122]	2024	Germany	Step 4: Treatment	Retrospective cohort analysis	To examine how outcome variability is distributed across centres and whether individual hospitals can be identified that consistently demonstrate high-quality outcomes, particularly across different colon cancer quality indicators (Qis).	153 centres	In the 153 centres, 90 082 patients with colon cancer and 47 623 patients with rectal cancer were treated. Average QI scores were 2.7% POM, 6.2% SSI, 4.8% AI-C, 8.5% AI-R, 9.1% RS-C, and 9.8% RS-R. The funnel plots revealed that for every QI, about 10.1% of hospitals lay above the upper 99% and about 8.7% below the lower 99% control limit. In POM, SSI, and AI-R, a significant negative correlation with the average annual caseload was observed.	The analysis showed high variability in outcome quality between and within the certified colorectal cancer centres. Only a small number of hospitals had a high performance on all six QIs, suggesting that significant quality variation exists even within the group of certified centres.
Krojer R [108]	2021	Denmark	Step 1: Prevention and early detection	Single-centre registry-based study	To assess if time-of-day dependent differences in colonoscopy quality exist in a Danish screening setting.	3659 screening colonoscopies	The adenoma detection rate (ADR) was 51% in the morning and 58% in the afternoon. Multivariate analysis found this statistically significant, with the “afternoon vs. morning” odds ratio for adenoma detection being 1.4 (95% confidence interval 1.17-1.68; $P<0.001$). The cecal intubation rate was 95.6% in the morning and 94.7%, a non-significant difference.	The ADR of screening colonoscopies was higher in the afternoon. Our study highlights the need for local/regional evaluation of factors affecting colonoscopy quality to address such issues. A clean colonoscopy exempts the patient from subsequent screening invitations for 8 years. Therefore, any observed systematic differences in quality must be addressed and eliminated.
Lal A [83]	2022	Australia	Step 7: End-of-life care	Benefits incidence analysis	To investigate variations in healthcare expenditure for colorectal cancer (CRC) patients in South Australia by socioeconomic position (SEP) and remoteness area.	981	The results indicated that MBS palliative healthcare services utilisation favoured the more advantaged groups for both SEP and remoteness area (Concentration index (CI) = 0.1681, t-value=54.42 (SEP) and CI=0.1546, t-value=41.64). MBS expenditure was also favourable to the more advantaged groups (CI: 0.0785 and 0.0493) PBS and MBS general practitioner expenditure were equal (–0.0093 to 0.0250).	Overall MBS and PBS healthcare expenditure for CRC patients was close to equality, however utilisation of MBS-funded palliative healthcare services was less concentrated in low SEP and more remote areas. Whether the differences in palliative healthcare utilisation supplied by private providers are offset by other services requires investigation to determine if there is a need for initiatives to improve equality and give greater support to those who choose to die at home.
Lamprell K [89]	2023	United Kingdom, Australia and New Zealand	Step 2: Presentation, initial investigations and referral	Mixed-methods	To investigate patients' accounts of early-onset colorectal cancer diagnosis published on prominent bowel cancer support websites in the United	273	Patients perceived that GPs' low suspicion of cancer due to age under 50 contributed to delays. Patients reported that their GPs seemed unaware of early-onset colorectal cancer and that they were not offered screening for colorectal cancer even when 'red flag' symptoms were present. Patients described experiences of inadequate information continuity within GP practices and across primary, specialist and tertiary levels of	Wider dissemination of information about early-onset colorectal cancer at primary care level is imperative given the increasing incidence of the disease, the frequency of diagnostic delay, the rates of late-stage diagnosis and the dissatisfaction with patient experience

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					Kingdom, Australia and New Zealand.		care, which they perceived contributed to diagnostic delay. Patients also reported tensions with GPs over the patient-centredness of care, describing discord related to symptom seriousness and lack of shared decision-making.	reported by patients whose diagnosis is delayed. Patient education about diagnostic protocols may help to pre-empt or resolve tensions between GPs' enactment of value-based care and patients' concerns about cancer. The challenges of diagnosing early-onset colorectal cancer are significant and will become more pressing for GPs, who will usually be the first point of access to a health system for this growing patient population.
Lamy S [90]	2019	France	Step 4: Treatment	Mixed-effects model	To examine whether and why adherence to guidelines differs between CRC care centres.	458 stage II (T3-4N0M0) patients (analysis 1), 397 stage III (N1-2M0) patients (analysis 2), and 516 stage IV (M1) patients (analysis 3)	There was higher adherence for the oldest than for the most recent recommendations; no CRH in recommendation No. 2 but lower adherence in academic centres; a CRH for recommendations No. 1 and 3; no SEP-related differences in clinical practices.	The results supported higher overall proportions of guidelines-based practices for the former clinical recommendations than for the most recent. The largest between-centres differences in guidelines adherence were not found for the most recent recommendations. The mechanisms of guidelines-based practices diffusion are unclear and seem to depend on the type of recommendation.
Layfield DM [124]	2022	United Kingdom	Step 6: Managing recurrent, residual or metastatic disease	Retrospective	To investigate the potential relationship between major changes in the treatments delivered by the multidisciplinary teams (MDT) and early mortality and crude survival in a cohort of patients with colorectal cancer managed by the MDT and among patients aged 80 years or older.	4617	The MDT managed 4617 patients over 14 years (1496 in the first interval and 1389 in the last). Over this time, there was a reduction in emergency resections from 15.5 per cent to 9.0 per cent (P<0.0001); use of oncological therapies increased from 34.6 per cent to 41.6 per cent (P<0.0001). The 90-day mortality after diagnosis of colorectal cancer dropped from 14.8 per cent to 10.7 per cent (P< 0.001) and 2-year survival improved from 58.6 per cent to 65 per cent (P<0.001). Among patients aged 80 years or older (425 and 446, in the first and last intervals respectively) there was, in addition, a progressive increase in 'no surgery' rate from 33.6 per cent to 50.2 per cent (P<0.0001) and a reduction in elective resections from 42.4 per cent to 33.9 per cent (P=0.010). The 90-day mortality after elective resection fell from 10.0 per cent (18 of 180) to 3.3 per cent (5 of 151; P=0.013).	Survival from colorectal cancer improved significantly over 14 years. Among patients aged ≥80 years, major changes in the type of treatment delivered were associated with a decrease in postoperative mortality.
Lee SJC [125]	2018	United States	Step 1: Prevention and early detection	Qualitative analysis	To understand how to optimise processes within and across clinics to enhance faecal immunochemical test (FIT), the preferred screening modality of the system	An integrated, safety-net system including a hospital, specialty clinics, and 12 primary care clinics serving primarily uninsured, low-income residents of Dallas County	There was substantial variation in protocols for distributing and returning FIT kits both within and across clinics. Providers, clinic and laboratory staff had differing access to important data about FIT results based on clinical information system used and this affected results reporting. Communication and coordination during electronic referrals for diagnostic colonoscopy was suboptimal particularly for co-morbid patients needing anaesthesia clearance.	The multi-level approach elucidated organisational deficiencies not evident by quantitative analysis alone. Findings indicate potential quality improvement intervention targets including: (1) best-practices implementation across clinics; (2) detailed communication to providers about FIT results; and (3) creation of EHR alerts to resolve pending colonoscopy referrals before they expire.
Lemmon E [109]	2024	Scotland (UK)	Step 4: Treatment	Retrospective	To provide contemporary, population level evidence on CRC treatment and survival in Scotland.	32,691	Overall, 32,691 (73%) and 12,184 (27%) patients had a diagnosis of colon and rectal cancer respectively, of whom 55% and 53% were early-stage and treated with surgery. Five-year overall survival (CRC specific survival) within this cohort	In a Scottish population of patients with early-stage CRC treated with surgery, there was significant variation in risk of

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							was 72% (82%) and 76% (84%) for patients with colon and rectal cancer respectively. Cox proportional hazards models revealed significant variation in mortality by sex, area-based deprivation and geographic location.	death, even after accounting for clinical factors and patient characteristics.
Lian S [126]	2024	China	Step 5: Care after initial treatment and recovery	Prospective longitudinal study (questionnaire)	To examine the changes in supportive care needs, quality of life and social support during different chemotherapy cycles among elderly colorectal cancer patients.	155	155 participants completed all questionnaire sessions across the six cycles. From pre-chemotherapy until after the sixth cycle of chemotherapy, the extent of physical and daily living requirements among all respondents fluctuated between 47.23% and 88.26%, psychological needs ranged from 60.84% to 97.67%, patient care and support needs ranged from 83.75% to 99.35%, healthcare system and information needs varied from 85.98% to 99.00%, while the level of sexual needs decreased from 1.51% to 0.65%. The mean Supportive Care Needs Survey-Short Form 34 (SCNS-SF34) scores for these participants ranged between 103.81 ± 2.28 and 144.10 ± 1.08. Significant increases over time were seen for all domains of SCNS-SF34 (F=126.99, 347.41, 65.00, 72.34, 160.15, p<0.001), keeping a clear upward trend, except for sexual needs (F=0.712, p=0.546). The mean Functional Assessment of Cancer Therapy (FACT-T) scores dropped from 68.80 ± 1.00 to 51.24 ± 1.40, while the mean Perceived social support scale (PSSS) scores dropped from 55.77 ± 0.83 to 43.28 ± 1.05. The scores of FACT-T and PSSS showed statistically significant differences (F=231.21, 112.28, p<0.001), maintaining clear downward trends.	During chemotherapy, elderly colorectal cancer patients continue to require high levels of supportive care, while their quality of life and social support gradually decline. This study offers healthcare practitioners a foundational understanding to identify and address the supportive care needs of elderly colorectal cancer patients across various chemotherapy phases, which facilitates the development of tailored strategies aimed at enhancing patients' quality of life.
Lizalek JM [54]	2024	United States	Step 4: Treatment	Retrospective national cohort-based study	To determine if hospital service volume (SV) for metastatic colorectal cancer could be predictive of nonstandard treatment patterns in stages I-III colon cancer.	189,959	There were significant associations between hospital-level SV for metastatic colorectal cancer and the odds of chemotherapy overtreatment among patients with stage I-III colon cancer, as well as under treatment among patients with stages II-III disease after adjusting for hospital-, patient-, and tumour-level covariates. Patients at the highest-level SV hospitals for metastatic disease had 1.29 higher odds (95% CI = 1.18-1.41; P < 0.0001) of receiving overtreatment compared to patients from lowest SV hospitals. The odds ratio of under treatment in highest SV compared to lowest SV was 0.64 (95% CI 0.56-0.72; 0.0001).	Hospital-level SV of patients with metastatic colon cancer is a significant indicator of nonstandard treatment patterns among patients with stage I-III colon cancer. Hospitals with the highest volume of cancer treatments have higher odds of providing overtreatment, while low SVs are associated with higher odds of under treatment.
MacCallum C [127]	2020	Australia	Step 4: Treatment	Retrospective	To compare types of CRC resection across Victorian geographical zones, using hospital volume and accredited training post status.	7596 resections	In 44 public hospitals over 6 years, 7596 CRC resections were performed. Patient age, American Society of Anesthesiologists Physical Status Classification System score and tumour stage were similar among groups. Colorectal Surgical Society of Australia and New Zealand (CSSANZ) accounted for nearly 50% of cases but the lowest percentage of emergencies (16.8%). The ratio of right-sided to left-sided plus rectal resections was greater for low-volume than high-volume centres (56.8% versus 40.4%), while left colon and rectal resections comprised a larger proportion of high-volume workload. High- compared with low-volume favoured ultra-low anterior resections (62% versus 33%) over abdominoperineal resections (38% versus 67%). Work patterns among high volume hospitals were similar regardless of remoteness or CSSANZ status.	This study demonstrated that administrative data can provide granular, clinically relevant information with population-wide coverage. Most public CRC resections in Victoria were performed in metropolitan hospitals. The majority of rectal cancer resections were performed in high-volume metropolitan centres but 15% were performed by low volume regional hospitals.
Magaji BA [128]	2019	Malaysia	Step 5: Care after initial treatment and recovery	Cross-sectional	To determine pattern of health-related quality of life and its associations among patients with colorectal cancer.	324	The mean (±standard deviation) age of patients was 62.5 (±13.6) years. Majority of them were Chinese (62.3%) followed by Malays (19.8%), Indians (14.8%) and others (3.1%). Colon cancer was 7-fold more common than rectal cancer (87% vs 13%). Majority of them were presented at Stage II (29.6%) and III (28.1) of TNM Staging. The mean (±SD) score for global	The findings suggest that there is decrease in sexual functioning despite good overall GHS/QOL among our colorectal cancer survivors. Fatigue, sleep loss and urinary frequency were the common symptoms after cancer

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							health status/quality of life (GHS/QOL) was 73.13 (±14.19). Good overall functionality (mean scores ≥80) was observed for physical, emotional, role, cognitive and social/family for QLQ-C30; body image, anxiety and weight for QLQ-CR29. The mean score for sexual functioning in men (32.95±28.81) and women (17.56±25.60) were low. Commonest symptoms were fatigue (22.29±17.40), urinary frequency (21.96 ± 24.22) and insomnia (18.42 ± 23.32). Those with lower GHS/QOL had stoma (p=0.044) and were of Chinese ethnicity (p<0.001). On multivariate analysis, ethnicity was the only independent predictor of GHS/QOL (95% confidence interval, 2.589 to 6.139, p<0.001).	treatment. Chinese patients had the poorest quality of life.
Martellucci CA [110]	2022	Italy	Step 1: Prevention and early detection	Cross-sectional	To evaluate the variation in screening uptake of the clusters of subjects assisted by single GPs.	The final sample consisted of 332 GPs' clusters, including a total of 120,178 subjects eligible for CRC screening	The final sample consisted of 332 GP clusters, including 120,178 eligible subjects. The overall province uptake was 38.0% ± 10.7%. The uptake was lower than 30% in one-fifth of the GP clusters, and higher than 45% in another fifth. At multi variable analysis, the significant predictors of uptake were younger GP age (p ¼ 0.010) and lower number of registered subjects (p < 0.001). None of the GP clusters with 500 subjects or more showed an uptake 545%.	The wide variation across GPs suggests they might substantially influence screening uptake, highlighting a potential need to increase their commitment to CRC screening. Further research is needed to confirm the role of the number of registered subjects.
Martinez ME [129]	2024	United States	Step 1: Prevention and early detection	Cluster-randomised trial	To present the effectiveness of a regional mailed faecal immunochemical test (iFIT) intervention at year 1 among participants who were not up to date with CRC screening at the time of randomisation.	26736	Among 26,736 patients who met eligibility criteria, approximately 58% were female, 55% were Hispanic individuals, and 44% were Spanish speaking. The proportion completing screening was 11.5 percentage points (ppts) (95% CI, 6.1–16.9 ppts) higher in intervention versus usual care clinics. Variation in differences between intervention and usual care clinics was observed by sex (12.6 ppts [95% CI, 7.2–18.0 ppts] for females; 8.8 ppts [95% CI, 4.7–13.9 ppts] for males) and by racial and ethnic group (13.8 ppts [95% CI, 7.0–20.6 ppts] for Hispanic individuals; 13.0 ppts [95% CI, 3.6–22.4 ppts] for Asian individuals; 11.3 ppts [95% CI, 5.8–16.8 ppts] for non-Hispanic White individuals; 6.1 ppts [95% CI, 0.8–10.4 ppts] for Black individuals).	A regional mailed FIT intervention was effective for increasing CRC screening rates across community health centre (CHC) systems serving diverse, low-income populations.
Murchie P [59]	2021	Denmark and Scotland	Step 3: Diagnosis, staging and treatment planning	Retrospective cohort study	To compare Denmark vs Scotland in the association between travel burden to healthcare, CRC pathway intervals, tumour stage at diagnosis and mortality.	5898	Travel-time to key healthcare facilities influenced the diagnostic experience and outcomes of CRC patients from Scotland and Denmark to some extent differently. The longest travel-times to a specialised hospital appeared to afford the most rapid secondary care interval, whereas moderate travel-times to hospital (about 20-60 minutes) appeared to impact on later stage and greater one-year mortality in Scotland, but not in Denmark. A U-shaped association was seen between travel-time to the GP and one year-mortality.	This is the first international data-linkage study to explore how different national geographies and health service structures may determine cancer outcomes. Future research should compare more countries and more cancer sites and evaluate the impact and implications of differences in national health service organisation.
O'Sullivan DE [111]	2022	Canada	Step 4: Treatment	Retrospective population-based cohort study	To determine treatment and outcome differences between early onset of colorectal cancer (eoCRC) patients and average-onset CRC patients (60-70 years of age) using recent data from a large Canadian province.	8748	There were 334 and 935 patients in the early-onset groups and 4606 in the aoCRC group. Compared with aoCRC, patients <40 were more likely to receive chemotherapy in stage II colon (OR 3.41, CI 1.75-6.47) and stage III rectal (OR 3.01, CI 1.18-10.21), and to receive systemic therapy (OR 2.40, CI 1.46-4.12) and radiation in stage IV CRC (OR 2.70, CI 1.48-4.92). The 40-49 age group was more likely to receive chemotherapy in stage II colon (OR 2.13, CI 1.25-3.56), and chemoradiation in stage II rectal (OR 2.16, CI 1.25-3.80) and stage III rectal (OR 1.63, CI 1.13-2.40), as well as systemic therapy in stage IV CRC (OR 2.46, CI 1.75-3.52). Survival did not differ between <40 and 60-70 age groups. Survival was significantly higher for the 40-49 age group, but only in stage IV (HR 0.79, CI 0.67-0.94).	EoCRC patients tended to receive more therapy than average age CRC patients with minimal survival gains. Additional research to identify optimal treatment strategies for eoCRC patients is required.

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Oyeyemi SO [65]	2019	Norway	No step: General focus on incidence	Prospective cohort study	To determine whether geographical distribution of lifestyle-related CRC risk factors can explain these geographical differences in CRC incidence in Norwegian women.	1875	During an average of 15.5 years of follow-up, 1875 CRC cases were diagnosed. Height (HR=1.12; 95% CI 1.08, 1.17 per 5 cm increase); being a former smoker who smoked ≥10 years (HR=1.34; 95% CI 1.15, 1.57); or being a current smoker who has smoked for ≥10 years (HR=1.28; 95% CI 1.12, 1.46) relative to never smokers was associated with increased CRC risk. Duration of education >12 years (HR=0.78; 95% CI 0.69, 0.87) vs ≤12 years, and intake of vegetables and fruits >300 g (HR=0.90; 95% CI 0.80, 0.99) vs ≤300 g per day were associated with reduced CRC risk. However, these risk factors did not account for the differences in CRC risk between geographical areas of low and high CRC incidence. This was further confirmed by the Karlson, Holm, and Breen (KHB) method using baseline and follow-up measurements (b=0.02, 95% CI -0.02, 0.06, p=0.26).	Lifestyle-related CRC risk factors did not explain the geographical variations in CRC incidence among Norwegian women. Possible residual explanations may lie in heritable factors.
Quaresma M [133]	2022	United Kingdom	Step 3: Diagnosis, staging and treatment planning	Retrospective	To examine the geographical variations in colon cancer outcomes among patients living in London (England) in order to examine whether geographical variation in cancer survival is associated with the hospital of care.	16326	Geographical disparities in colon cancer survival disappeared once controlled for hospitals, and the disparities seemed to be augmented between hospitals. However, close examination of patient pathways revealed that the poorer survival observed in some hospitals was mostly associated with higher proportions of emergency diagnosis, while their performance was generally as expected for patients diagnosed through non-emergency routes.	This study highlights the need to better coordinate primary and secondary care sectors in some areas of London to improve timely access to specialised clinicians and diagnostic tests. This challenge remains crucially relevant after the recent successive regroupings of Clinical Commissioning Groups (which grouped struggling areas together) and the observed exacerbation of disparities during the COVID-19 pandemic.
Roberts TJ [112]	2023	United States	Step 4: Treatment	Cross-sectional	To compare rates of molecular testing and targeted therapy use by practice type and across practices.	106 228	There were 106 228 Medicare beneficiaries with incident NSCLC (31 521 [29.7%] aged 65-69 years; 50 348 [47.4%] female patients; 2269 [2.1%] Asian, 8282 [7.8%] Black, and 91 215 [85.9%] White patients) and 39 512 beneficiaries with incident CRC (14 045 [35.5%] aged 65-69 years; 17 518 [44.3%] female patients; 896 [2.3%] Asian, 3521 [8.9%] Black, and 32 753 [82.9%] White patients) between 2015 and 2019. Among these beneficiaries, 18 435 (12.9%) were treated at National Cancer Institute (NCI)-designated centres, 8187 (5.6%) were treated at other academic centres, and 94 329 (64.7%) were treated at independent oncology practices. Molecular testing rates increased from 74% to 85% for NSCLC and 45% to 65% for CRC. First-line targeted therapy use decreased from 12% to 8% among patients with NSCLC and was constant at 5% for patients with CRC. For NSCLC, molecular testing rates were similar across practice types while rates of multigene panel use (13.2%) and targeted therapy use (16.6%) were highest at NCI-designated cancer centres. For CRC, molecular testing rates were 3.8 (95% CI: 1.2-6.5), 3.3 (95% CI, 0.4-6.1), and 12.2 (95% CI, 9.1-15.3) percentage points lower at hospital-owned practices, large independent practices, and small independent practices, respectively. Rates of targeted therapy use for CRC were similar across practice types. After adjusting for patient characteristics, there was moderate variation in molecular testing and targeted therapy use across oncology practices.	In this cross-sectional study of Medicare beneficiaries, molecular testing rates for NSCLC and CRC increased in recent years but remained lower than recommended levels. Rates of targeted therapy use decreased for NSCLC and remained stable for CRC. Variation across practices suggests that where a patient was treated may have affected access to recommended testing and efficacious treatments.
Rogers M [130]	2018	Australia	Step 4: Treatment	Retrospective population-based analysis	To examine the treatment and care for CRC patients in regional/rural Southwest Victoria and any deviations	311	There were 298 newly diagnosed patients (71.8yrs SD 12.6yrs) in 2015. Private health insurance (PHI) was held by 142 (48%) and not by 144 (49%) (11 Veterans' Affairs excluded). A higher proportion with PHI had a colonoscopy	More patients who held PHI were receiving treatment and care within required time frames and had better short-term survival.

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					from optimal recommendations		within 4 weeks of referral (79% versus 52%) and their first surgical consultation within 2 weeks (76% versus 47%). More with PHI had surgery performed (88% versus 77%), fewer were presented to a multidisciplinary meeting to discuss treatment options (47% versus 77%) and had a higher survival rate for the first 12 months (92% versus 79%) (all $p < 0.02$). 	
Salika T [115]	2018	United Kingdom	Step 3: Diagnosis, staging and treatment planning	Patient (postal) survey linked to information on diagnostic route	To examine how different pathways to diagnosis of CRC may be associated with the experience of subsequent care.	6837	For 14 of 18 questions, there was evidence ($p \leq 0.02$) for variation in patient experience by diagnostic route, with 6–31 percentage point differences between routes in adjusted proportions of negative experience. Emergency presenters were more likely to report a negative experience for most questions, including those about adequacy of information about their diagnosis and sufficient explanation before operations. Screen-detected patients were least likely to report negative experiences except for support from primary care. Patients diagnosed through elective primary care referrals were most likely to report worse experience for questions for which overall variation by route was generally small	Screening-detected patients tend to report the best and emergency presenters the worst experience of subsequent care. Improvement efforts can target care integration for screening-detected patients and provision of information about the diagnosis and treatment of emergency presenters.
Scheepers ER [48]	2021	The Netherlands	Step 4: Treatment	Retrospective population-based analysis	To assess age-related treatment patterns and primary reasons for adjusted treatment in patients with CRC.	29620	Of all 29,620 patients, 30% were aged <65 years ($n = 8994$), 34% between 65 and 75 years ($n = 10,173$), 27% between 75 and 85 years ($n = 8102$) and 8% were ≥ 85 years ($n = 2349$). Irrespective of cancer location or stage, older patients received less frequently a combination of surgery and (neo)adjuvant therapy compared to younger patients (decreasing from 55% to 1% in colon cancer patients, and from 71% to 23% in rectal cancer patients aged <65 years and ≥ 85 years respectively). Omission of surgical treatment increased with age in both patients with colon cancer (ranging from 1% in patients aged <65 years to 16% in those ≥ 85 years) and rectal cancer (ranging from 12% in patients aged <65 years to 56% in those ≥ 85 years). The most common reasons for adjusted treatment were patient preference (27%) and functional status (20%), both reasons increased with advancing age.	Guideline non-adherence increased with advancing age and omission of standard treatment was mainly based on patient preference and functional status. These findings provide insight in the treatment decision-making process in patients with colorectal cancer. Future research is necessary to further assess patient's role in the treatment decision-making process.
Schneider JL [93]	2020	United States	Step 1: Prevention and early detection	Observational cohort study	To identify major, potentially modifiable factors related to CRC mortality the researchers evaluated a large, diverse, multicentre cohort of patients with a diagnosis of CRC, and contrasted CRC mortality and all-cause mortality across 6 distinct health care systems. Additionally, the researchers evaluated whether patient-related factors (age, race / ethnicity, comorbidities) and health care system-related differences in stage-specific cancer treatments and in cancer stage (a surrogate for effective CRC screening) explained the differences found.	14,672	Among 16,211 patients with CRC, there were significant differences between health care systems in CRC stage at diagnosis, CRC-specific mortality, and all-cause mortality. The unadjusted risk of CRC mortality varied from 27% lower to 21% higher than the reference system (hazard ratio [HR] = 0.73, 95% confidence interval = 0.66–0.80 to HR = 1.21, 95% confidence interval = 1.05–1.40; $p < 0.01$ across systems). Significant differences persisted after adjustment for demographics and comorbidities ($p < 0.01$); however, adjustment for stage eliminated significant differences ($p = 0.24$). All-cause mortality among patients with CRC differed approximately 30% between health care systems (HR = 0.89–1.17; $p < 0.01$). Adjustment for age eliminated significant differences ($p = 0.48$).	Differences in CRC survival between health care systems were largely explained by stage at diagnosis, not demographics, comorbidity, or treatment. Given that stage is strongly related to early detection, these results suggest that variation in CRC screening systems represents a modifiable systems-level factor for reducing disparities in CRC survival.

First author	Year	Country	OCP Step	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Shen L [52]	2020	China	Step 4: Treatment	Observational	To describe direct medical costs associated with each line of treatment among metastatic colorectal cancer (mCRC) patients in China.	404	Of the 404 mCRC patients, the mean age was 55 years old and 62% were male. Oxaliplatin and irinotecan-based regimens dominated first- and second-line treatment, respectively (44 and 37%). From first- to second- to third-line, the proportion of patients receiving targeted biologics increased from 18% at first-line and 12% at second-line to 34% at third line; median number of treatment cycles reduced from 6 to 4 and to 2. The corresponding mean direct medical costs per person per cycle increased from \$2,514 to \$2,678 to \$5,121. Mean drug costs per cycle increased from \$2,314 to \$2,673 to \$4,316 among patients receiving chemotherapy alone and from \$3,245 to \$2,717 to \$6,533 among patients receiving chemo- and biologics-combined therapy	Before 2017, mCRC patients in China did not receive the maximum benefits of precision medicine breakthroughs. Reduced treatment cycles and increased costs per cycle from first- to third line suggested poor healthcare resource utilisation. With earlier initiation and more treatment cycles, targeted biologics may better demonstrate their effectiveness among Chinese patients. Our findings reflected the urgent need to increase drug accessibility in China before 2017 and underscore that including innovative biologics into Chinese health insurance plans can reduce patients' economic burden and improve the management of mCRC.
Siddiqui MT [94]	2014	Pakistan	Step 5: Care after initial treatment and recovery	Cross-sectional	To evaluate the quality of life (QoL), anxiety & depression in CRC patients and their association with clinicopathological features at a tertiary care hospital in Karachi Pakistan, a low middle income country (LMIC).	127	A total of 127 CRC patients were included in this study with a mean age of 53±15 years. Majority were male (70%), married (83.5%), and living in combined family system (52.7%). Mean Global QoL score in our patients was 69.08±1.78. Among symptoms scales, stoma care problem, dry mouth and urinary frequency were 3 worst symptoms respectively. Among functional scales, sexual interest (women > men) was the most significantly affected aspect. Anxiety and Depression were seen in 26 (20.9%) and 24 (18.9%) patients, respectively. On multivariable linear regression adjusted for covariates, lower global QoL was significantly associated with depression (Adjusted Beta Coefficient: -25.33 [95% Confidence Interval: -34.4, -16.23]), patients on adjuvant treatment (-15.14 [-21.84, -8.44]), and those who received neo adjuvant treatment (-11.75 [-19.84, -3.65]).	This is the first study to assess the QoL in CRC patients in Pakistan. Depression was found to be significantly associated with poor quality of life. Numerous factors were identified which correlated with QoL indicating the need to develop local guidelines to help our patients cope with the psychological distress.
Siegel RL [139]	2019	International (21 countries)	No step: General (focus on incidence)	Cross-sectional	To examine global trends of CRC incidence.	21 countries	During 2008–2012, age-standardised CRC incidence rates in adults <50 ranged from 3.5 per 100 000 (95% CI 3.2 to 3.9) in India (Chennai) to 12.9 (95% CI 12.6 to 13.3) in Korea. During the most recent decade of available data, incidence in adults <50 was stable in 14 of 36 countries; declined in Austria, Italy and Lithuania; and increased in 19 countries, nine of which had stable or declining trends in older adults (Australia, Canada, Denmark, Germany, New Zealand, Slovenia, Sweden, UK and USA). In Cyprus, Netherlands and Norway, inclines in incidence in young adults were twice as rapid as those in older adults (e.g., Norway average annual per cent change (AAPC), 1.9 (95% CI 1.4 to 2.5) vs 0.5 (95% CI 0.3 to 0.7)). Among most high-income countries with long-term data, the uptick in early-onset disease began in the mid-1990s. The steepest increases in young adults were in Korea (AAPC, 4.2 (95% CI 3.4 to 5.0)) and New Zealand (AAPC, 4.0 (95% CI 2.1 to 6.0)).	CRC incidence rates are uniquely increasing in young adults in nine high-income countries (Germany, USA, Australia, Canada, New Zealand, UK, Denmark, Slovenia and Sweden) across North America, Europe and Oceania where rates in older adults are stable or declining. Conversely, CRC declined in young adults in only three countries (Italy, Austria and Lithuania) compared with 11 countries in adults 50 and older potentially signalling changes in early-life exposures that influence large bowel carcinogenesis.
Singh R [77]	2022	United States	Step 1: Prevention and early detection	Review of patient charts	To evaluate the difference in surveillance colonoscopy rates between white people and African Americans who had their colon tumours resected and to determine whether the COVID-19	800	The surveillance colonoscopy rates among African Americans were 54% before and 45% during the pandemic. This difference was significant (p < 0.001). The colonoscopy rates between whites and African Americans differed. The surveillance colonoscopy rates among whites were 97% before and 84% during the pandemic. The distance between the patients' homes and the hospital where the procedure was	A significant difference was observed in the colonoscopy rates for African Americans before and during the pandemic. A substantial difference was found in the colonoscopy rates between whites and African Americans, which increased during the pandemic. The

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					pandemic affected these colonoscopy rates.		performed also significantly differed. The average travel distance for whites was 1.33 miles and that for African Americans was 3.98 miles (p < 0.001). A total of 215 of the 416 African American patients included had tumours in the cecum and ascending colon.	distance from the patients' home to the hospital performing the colonoscopy was twice as far for African Americans than whites in the borough of Brooklyn. These data support the hypothesis that a significant difference in colonoscopy rates exists between African Americans and whites, probably because of a healthcare disparity in access to this procedure. The study objective was to highlight the long-standing issue of low colonoscopy rates in African Americans and how the pandemic further decreased these low rates.
Smith HG [116]	2023	International (Australia, Belgium, Denmark, France, Germany, Italy, Israel, Pakistan, The Netherlands, Spain, Sweden, United States)	Step 4: Treatment	Online survey via social media	To investigate variations in the definition of microscopically positive resection margins (R1) margins in colorectal cancer and the importance of margin status in clinical decision-making.	137 responses were received	Most respondents were from Europe (89.7%), with the majority from Denmark (56.9%). Less than 2/3 of respondents defined R1 margins as the presence of viable cancer cells ≤ 1 mm of the margin. Only 60% reported that subdivisions of R1 margins (primary tumour vs tumour deposit vs metastatic lymph node) are routinely available. More than 20% of respondents reported that pathology reports are not routinely reviewed at MDT meetings. Less than half of respondents considered margin status in decision-making for type and duration of adjuvant chemotherapy in Stage III colon cancer.	The definitions and perceived clinical importance of microscopically positive margins in patients with colorectal cancer appear to vary. Adoption of an international dataset for pathology reporting may help to standardise current practices.
Sokale IO [95]	2023	United States	Step 1: Prevention and early detection	Cross-sectional study	To assess the patterns of up-to-date colorectal cancer screening rates among racial/ethnic groups across the U.S. Census Bureau Divisions.	779143	The overall proportion of individuals with up-to-date colorectal cancer screening increased from 66.5% in 2014 to 72.5% in 2020 (p<0.001). For racial/ethnic subgroups, from 2014 to 2020, screening rates increased significantly among non-Hispanic Whites (68.5%–74.5%, p<0.001), non-Hispanic Blacks (68.0%–74.6%, p<0.001), and Hispanics (51.5%–62.8%, p<0.001). However, increases were not observed in all U.S. Census Bureau Divisions.	Although colorectal cancer screening rates improved over time, they fall short of the 80% target. Substantial racial/ethnic and geographic disparities remain. Future studies investigating the factors influencing these disparities are needed.
Steindorf K [79]	2020	Germany	Step 5: Care after initial treatment and recovery	Cross-sectional survey	To examine and compare pre- to post-diagnosis change patterns of physical activity (PA) among breast, prostate, and colorectal cancer patients. Moreover, the study aimed to investigate sociodemographic and medical determinants of post-diagnosis PA and to identify patient subgroups at increased risk of inactivity	214	For colorectal cancer patients, meeting guidelines pre-diagnosis was the only significant predictor of meeting guidelines post-diagnosis (p < .001)	While prostate and colorectal cancer patients reported comparatively high pre-diagnosis PA and a strong decrease in higher-intensity PA, breast cancer patients showed a more constant behaviour and were the only group with no decrease in the proportion of sufficiently active patients
Sun, J [22]	2018	Australia	Step 1: Prevention and early detection	Ecological analysis	To examine if geographic variations in the participation rates in the National Bowel Cancer Screening Program (NBCSP) are related to population-level socio-demographic characteristics.	504 Local Government Areas (LGAs)	Compared to the participation rate for major cities (33.4%), participation was significantly higher in inner regional areas (36.5%, OR=1.15), but was much lower in remote (27.9%, OR=0.77) or very remote areas (25.0%, OR=0.65). When controlling for study period, gender, proportion of persons aged 65 years and older, Indigenous status, cultural background and socioeconomic status, significantly higher rates were observed in all non-metropolitan areas than in major cities. Indigenous status was strongly related to the poorer participation in remote areas.	Socio-demographic characteristics, particularly Indigenous status, cultural background and population ageing, seem to be more important drivers of regional disparities in NBCSP participation than geographic remoteness. This study provides important evidence to understand the regional disparities in

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								participating in the national screening program.
Sun M [140]	2020	Sweden	No step: General population characteristics	Retrospective cohort study	To better understand the sex-specific incidence and survival of CRC during recent decades, using data derived from the nationwide Swedish Cancer Register to describe the overall and age-specific temporal trends of male to-female age-standardised incidence rate ratios (IRR) and male-to-female age-standardised five-year survival rate ratios (SRR) of RCC, LCC, and rectal cancer between 1960 and 2014.	66229	The overall male-to-female IRR was 1.05 for right sided colon cancer (RCC), 1.31 for LCC, and 1.66 for rectal cancer. Male-to-female IRR increased steadily for RCC by an average of 0.4% per year until the mid-1990s and then decreased gradually by an average of 1.0% per year. Left sided colon cancer (LCC) patients showed an increase of 0.6% per year since the mid-1970s. For rectal cancer, a non-significant random fluctuation was noted during the study period. The temporal trends of male-to-female IRR varied by age at diagnosis. The male-to-female SRR was 0.87 for RCC, 0.88 for LCC, and 0.86 for rectal cancer, which remained relatively stable during the study period.	Sex disparity of CRC is age-, period-, and anatomical subsite-dependent. Further studies are needed to investigate the underlying contributing factors.
Taylor JC [91]	2021	United Kingdom	Step 4: Treatment	Mixed-methods	To quantify any variation in adjuvant chemotherapy treatment across England and to explore this variation in greater detail using the large representative region of Yorkshire.	23402	The national adjusted chemotherapy treatment rate ranged from 2% to 46% (Stage II cancers), 19% to 81% (Stage III cancers), 24% to 75% (patients aged <70 years) and 5% to 46% (patients aged ≥70 years). Regionally, the rates of treatment and the proportions of treated patients receiving combination chemotherapy varied by stage (Stage II 4%-26% and 0%-55%, Stage III 48%-71% and 40%-84%) and by age (<70 years 35%-68% and 49%-91%; ≥70 years 15%-39% and 6%-75%). Questionnaire responses showed significant variations in opinions for high-risk Stage II patients with both deficient and proficient mismatch repair tumours and Stage IIIB patients aged ≥70 years.	Following a review of the evidence, open discussion in our region has enabled a consensus agreement on an algorithm for colorectal cancer that is intended to reduce variation in practice.
te Marvelde L [113]	2019	Australia	Step 5: Care after initial treatment and recovery	Retrospective population-based	To test the hypothesis that improved patients' outcomes are associated with receiving care aligned to the OCP.	13539	Alignment with the prevention phase of the OCP occurred for 88% of 13,539 individuals and was associated with lower disease stage at diagnosis (OR = 0.33, 95% confidence interval 0.24 to 0.42), improved crude three-year survival (69.2% versus 62.2%; p < 0.001) and reduced likelihood of emergency surgery (17.7% versus 25.6%, p < 0.001). For patients treated first with surgery (n = 10,807), care aligned with the diagnostic and treatment phase indicators (44% of patients) was associated with a survival benefit (risk-adjusted HRnon-aligned vs aligned = 1.23, 95% confidence interval 1.13 to 1.35), better perioperative outcomes and higher alignment with follow-up and end-of-life care. The survival benefit persists adjusting for potential confounding factors, including age, sex, disease stage and comorbidity	This population-based study shows that care aligned to a pathway based on best principles of cancer care is associated with improved outcomes for patients with colon cancer.
Thulin T [45]	2021	Sweden	Step 1: Prevention and early detection	Retrospective	To assess sociodemographic changes in the population frequency of colonoscopy (PFC); number of colonoscopies per 1000 inhabitants per year) among people aged 50–74 in relation to the implementation of a regional colorectal cancer screening programme for people aged 60–69 in the Stockholm-	303687 colonoscopies	The PFC largely increased during 2006–2015 in all six Swedish regions. The estimated increase in the pre- vs. post period PFC (DPFC) within the RSG was (i) greater for men than for women (5.8 vs. 4.5) and (ii) smaller for people aged 70–74 than for those aged 60–69 (5.5 vs. 9.0), while the corresponding DPFCs within each of the other regions were (i) not greater, or even smaller, for men and (ii) not smaller, or even larger, for elderly people aged 70–74.	A regional implementation of an organised colorectal cancer screening programme did not lead to a higher PFC increase in the screening relevant age group 50–74 years. Nevertheless, changes in the PFC were more pronounced for men and less pronounced for people aged 70–74 than those invited to participate in the screening programme (60–69 years), as compared with the rest of Sweden

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					Gotland region (RSG) in 2008.			(without organised colorectal cancer screening).
Trogdon JG [117]	2018	United States	Step 5: Care after initial treatment and recovery	Retrospective	To estimate the association between provider and team experience and adherence to guidelines, survival, and utilisation among colorectal cancer patients in North Carolina.	7295	Patients whose surgeons shared >40% of their colorectal cancer patients in the previous year with a medical oncologist were (1) more likely to have had a consultation with a medical oncologist [marginal effect (ME)=13.3 percentage points, P-value<0.001], (2) less likely to receive a surveillance colonoscopy within 12 months (ME=3.5 percentage points, P-value=0.049), and (3) received more radiology studies (ME=0.254 studies, P-value=0.029). Patients whose surgeon and medical oncologist shared >20% of their colorectal cancer patients with each other in the previous year had a higher likelihood of receiving adjuvant chemotherapy (ME=11.5 percentage points, p value<0.001) and surveillance colonoscopy within 12 months (ME=6.7 percentage points, P-value=0.030) and within 18 months (ME=6.2 percentage points, P-value=0.054).	The study shows that team experience is associated with patients' quality of care, survival, and utilisation.
Van Abbema D [46]	2019	The Netherlands	Step 4: Treatment	Retrospective	To investigate trends in survival rates and treatment patterns over time for older versus younger patients with breast cancer (BC) and CRC in the Netherlands	127146	During the study period (2003-2012), 98% of BC patients aged <75 years underwent surgery, whereas for patients ≥75 years, rates were 79.3% in 2003 and 66.7% in 2012 (p < 0.001). Most CRC patients underwent surgery irrespective of age or time period, although patients with rectal cancer aged ≥75 years received less surgery or radiotherapy over the entire study period than younger patients. The administration of adjuvant chemotherapy increased over time for CRC and BC patients, except for BC patients aged ≥75 years. The five-year relative survival improved only in younger BC patients (adjusted relative excess risk of death (RER) 0.95–0.96 per year) and was lower for older BC patients (adjusted RER 1.00, 95% Confidence Interval (CI) 0.98–1.02, and RER 1.00; 95% CI 0.98–1.01 per year for 65–74 years and ≥75 years, respectively). For CRC patients, the five-year relative survival improved over time for all ages (adjusted RER on average was 0.95 per year).	The observed survival trends in BC and CRC patients suggest advances in cancer treatment, but with striking differences in survival between older and younger patients, particularly for BC patients.
Vu JV [96]	2021	United States	Step 1: Prevention and early detection	Retrospective population-based	To examine variation in the rates of colectomy surgery for CRC and benign polyps at the population level.	280815	Of 280,815 patients, 157,802 (65.8%) underwent colectomy for CRC compared to 81,937 (34.2%) for benign polyp. Across HRRs, colectomy rates varied 5.8-fold for cancer (0.32–1.84 per 1000 beneficiaries). However, there was a 69-fold variation for benign polyp (0.01–0.69). While the rate of colectomy for CRC was correlated with the rate of colectomy for benign polyp (slope=0.61, 95% CI 0.48–0.75), hospital referral region (HRRs) with the lowest or highest rates of colectomy for CRC did not necessarily have similarly low or high rates for benign polyp.	The use of colectomy for benign polyp is much more variable compared to CRC, suggesting overuse of colectomy for benign polyp in some regions. This variation may stem from provider-level differences, such as endoscopists' referral practice or skill or surgeons' decision to perform colectomy, or from limited access to advanced endoscopists. Interventions to increase endoscopic resection of benign polyps may spare some patients the morbidity and cost of surgery.
Wang CP [66]	2023	United States	Step 1: Prevention and early detection	Retrospective	To describe CRC incidence trends among Asian Americans based on US geography	25776	Asian American case counts in the Midwest and South were smaller than in the West and Northeast, in part because Asian Americans are more densely concentrated in coastal regions. Despite these limitations, the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) 21 encompasses the largest geographic coverage to date, inclusive of 63% Asians and 69% Native Hawaiian/Pacific Islanders, which allows for a 24% increase in Asian representation from older registries and offers new insights on	The researchers found marked variation in CRC incidence among Asian Americans by US geographic region. Future studies that investigate regional differences in CRC incidence among disaggregated Asian subgroups would be informative considering their projected rapid expansion. A deeper understanding regarding the complex

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							regional CRC incidence patterns among this fastest growing racial group.	interaction between genetic predisposition, modifiable risk factors, and health behaviours, and cultural beliefs for each Asian subgroup is needed to achieve similar if not greater rates of decline in CRC incidence as has been observed in other racial and ethnic groups.
Webber C [118]	2022	Canada	Step 5: Care after initial treatment and recovery	Retrospective cohort study	To evaluate if regional variation in colon cancer survival may be driven by differences in the patient population, their health and healthcare utilisation, and/or cancer care delivery.	30061	The study population included 16 895 patients with colon cancer. There was statistically significant regional variation in cancer-specific survival. Three regions had cancer-specific survival that was between 30% (95% CI 1.03 to 1.65) and 39% (95% CI 1.13 to 1.71) longer and one region had cancer-specific survival that was 26% shorter (95%CI 0.58 to 0.93) than the reference region. For three of these regions, case mix explained between 26% and 56% of the survival variation. Further adjustment for rurality explained 22% of the remaining survival variation in one region. Adjustment for continuity of primary care and the diagnostic interval length explained 10% and 11% of the remaining survival variation in two other regions. Socioeconomic marginalisation, recent immigration and colonoscopy history did not explain colon cancer survival variation.	Case mix accounted for much of the regional variation in colon cancer survival, indicating that efforts to monitor the quality of cancer care through survival metrics should consider case mix when reporting regional survival differences. Future work should repeat this approach in other settings and other cancer sites considering a broad range of potential mediators.
Xu R [53]	2020	China	Step 4: Treatment	Retrospective cohort study	To describe baseline characteristics of CRC and mCRC patients, to investigate prognosis in CRC patients, as well as to understand treatment patterns and sequences in mCRC patients using a multi-centre oncology database.	8246	Among mCRC patients (3878/8136, 48%), the fluorouracil, leucovorin, and oxaliplatin (FOLFOX) and other oxaliplatin-based regimens were the most widely used first-line treatment (42%). Fluorouracil, leucovorin, irinotecan (FOLFIRI) and other irinotecan-based regimens dominated the second-line (40%). There was no dominated regimen for the third-line. The proportion of patients receiving chemotherapy with targeted biologics increased from less than 20% for the first- and second- lines to 34% for the third-line (p < 0.001). The most common sequence from first- to second-line was from FOLFOX and other oxaliplatin-based regimens to FOLFIRI and other irinotecan-based regimens (286/1200, 24%).	The study's findings reflected a lack of consensus on the choice of third-line therapy and limited available options in China. It is evident o continue promoting early CRC diagnosis and to increase the accessibility of treatment options for mCRC patients. As the only nationwide large-scale study among CRC and mCRC patients before more biologics became available in China, our results can also be used as the baseline to assess treatment pattern changes before and after more third-line treatment were approved and covered into the National Health Insurance Plan in China between 2017 and 2018.
Young JM [47]	2018	Australia	Step 5: Care after initial treatment and recovery	Cross-sectional	To investigate patterns and predictors of follow up and survivorship care received and recommended for adults with colorectal cancer in New South Wales (NSW), Australia.	1007	Of 1007 eligible people, 560 (56%) participated in the NSW Bowel Cancer Care Survey with 483 (86% of study participants, 48% of invited sample) completing the survivorship survey. Among these 483 participants, only 110 (23%, 95% Confidence Interval CI 19–27%) had received a written follow up plan, with this more common among migrants, non-urban dwellers and those with little experience of the health system. Of 379 (78%) people treated with curative intent, most were receiving ongoing colorectal cancer follow up from multiple providers with 28% (23–32%) attending three or more different doctors. However, less than half had received guideline-recommended follow-up colonoscopy (46%, CI 41–51%) or carcino-embryonic antigen assay (35%, CI 30–40%). Socio-economic advantage was associated with receipt of guideline-recommended care. While participants reported high interest in improving general health and lifestyle since their cancer diagnosis, few had received advice about	Survivorship care was highly variable, with evident socioeconomic disparities and missed opportunities for health promotion.

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							screening for other cancers (24%, CI 19–28%) or assistance with lifestyle modification (30%, CI 26–34%). Less than half (47%, CI 43–52%) had discussed their family's risk of cancer with a doctor since their diagnosis.	
Zhang M [92]	2024	China, Australia	Step 3: Diagnosis, staging and treatment planning	Single-institution, cross-sectional pilot study	To assess the level of supportive care needs of caregivers of colorectal cancer patients and explore the related key influencing factors.	283	The caregivers of patients with colorectal cancer have a moderate level of needs, scored at 2.71 ± 0.42 . Caregiver preparedness, benefit funding, and financial toxicity were significantly negatively associated with the supportive care needs of caregivers ($r = -0.555, p < 0.001$; $r = -0.534, P < 0.001$; and $r = -0.615, p < 0.001$, respectively). Our multivariate regression analysis identified some factors that directly affected the supportive care needs of caregivers, including the duration of illness, tumour stage, the age and educational level of caregivers, caregiver preparedness, benefit funding, and financial toxicity ($R^2 = 0.574, F = 23.337, P < 0.001$).	Supportive care needs are common among caregivers of colorectal cancer patients. Higher caregiver preparedness, benefit funding, and financial toxicity tend to ease these needs. Healthcare workers should have an in-depth understanding of the needs of caregivers of colorectal cancer patients and actively provide targeted financial/informational/technical/emotional support to promote nursing skills and reduce caregivers' burdens.

Table 3. Summary of the evidence base – Grey literature (n=3)

First author	Year	Country	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
Delisle, M [137]	2019	Canada	Thesis	Objectives were two-fold: first, to re-examine the overall quality of CRC care in Manitoba, and second, to determine the association between quality of CRC care and healthcare costs.	7959	In part one, there was significant improvements in the overall Provincial performance in CRC-related quality indicators (Qis), but some concerning trends existed based on geography and hospital volume. In part two, we found increasing trends in wait times for colon and rectal cancer treatment are associated with increased healthcare costs. Among hospitals performing curative resection for CRC, the average rate of postoperative morbidity and mortality varied significantly. Hospitals with higher average rates of morbidity and mortality had increased healthcare costs. Finally, among patients dying of CRC in Manitoba, there appeared to be an underutilisation of palliative care, and patients who did not receive palliative care experienced increased healthcare utilisation and costs at the end-of-life.	The quality of CRC care in Manitoba is highly variable. Not only does this variation have negative consequences on patients, but it is also an economic burden on the healthcare system. We need to develop strategies to monitor and improve the quality and decrease the costs of CRC care in Manitoba.
Guan Z [138]	2018	Canada	Thesis	To differentiate diagnostic pathways in colorectal cancer in Ontario through the development of a pathway categorisation scheme, and evaluate the patient-, disease-, system-related characteristics of patients and the length of the diagnostic interval across the diagnostic pathway categories.	Six distinct diagnostic pathways were identified: asymptomatic pathway (N=4,494), colonoscopy pathway (N=10,066), the imaging and colonoscopy pathway (N=3,427), imaging alone pathway (N=2,238), the imaging and emergency presentation pathway (N=2,849) and no pre-diagnostic workup pathway (N=887).	Patients who went through a pathway that was more adherent to diagnostic pathway guidelines (e.g. asymptomatic pathway) were more likely to be younger, healthier and living in less deprived areas, and they tended to be diagnosed at an early stage with a short diagnostic interval. Patients who were female, older, living in more deprived areas and with more comorbid disease were more likely to go through pathways that were divergent from those guidelines. The length of the diagnostic interval was correlated to the number of colorectal cancer diagnosis-related visits occurring during the interval. All examined factors and the diagnostic interval were significantly associated with the pathway categorisation (p<0.0001).	This study demonstrated substantial variations in CRC diagnostic pathways in Ontario. Interventions should be designed to provide individualised and more effective diagnostic services to patients.
Sturley CE [60]	2021	United Kingdom	Thesis	To investigate spatial and social variations in CRC incidence, survival and mortality in England and Wales.		Spatial variation in CRC mortality was observed, but there was no clear pattern by LA or area deprivation, in contrast to that for all cancers combined. A stronger association was found between individual socio-economic attributes (educational attainment, social class and housing tenure) and both CRC incidence and survival. The CRC risk index revealed greater distance to health services and green space was associated with worse CRC outcomes and surprisingly closer proximity to retail outlets was associated with better CRC outcomes. No associations of the risk index and stage at diagnosis were found.	Understanding spatial and social variations in CRC is important to inform policies and target interventions to reduce inequalities. Access to up-to-date data is essential to monitor current health outcomes, while combining more traditional datasets with novel data offers potential to examine these relationships in more detail.
Victorian Department of Health and Human Services [36]	2019	Australia	Report	To investigate deviations from the CRC OCP for CRC.	18,621 (2011-2015)	Incidence <ul style="list-style-type: none"> The age-standardised incidence rate decreased from 39 per 100,000 in 1982 to 35 per 100,000 in 2015. Over the five-year period from 2011 to 2015, incidence was higher in regional than metropolitan ICS (range: 37–42 per 100,000 vs 32–34 per 100,000). 	Several key variations for local action were identified from the 2018 CRC summit event as follows: <ul style="list-style-type: none"> NEMICS - Sixty-three per cent of colorectal cancer (stage III) patients who had surgery are achieving timely adjuvant chemotherapy (within 56 days).

First author	Year	Country	Study design	Objective(s)	Participants (N)	Outcomes/Results	Key findings
						<p>Stage IV at diagnosis</p> <ul style="list-style-type: none"> Twenty-four per cent of colorectal cancer patients had metastatic disease at or within four months of diagnosis. Patients in GICS were more likely to present with distant metastases compared with other ICSs. <p>Survival</p> <ul style="list-style-type: none"> Five-year relative survival increased from 49 per cent in 1986–1990 to 69 per cent in 2011–2015. Compared with the Victorian average, survival was poorer for colon cancer patients living in LMICS and rectal cancer patients in SMICS, and better for rectal cancer patients in HRICS. <p>Presentation</p> <ul style="list-style-type: none"> Over 2011–2015, 14 per cent of first colorectal cancer surgeries occurred during an emergency admission. Surgery performed in an emergency admission: <ul style="list-style-type: none"> increased over time from 13 per cent in 2011 to 15 per cent in 2015 was lowest for stage I (three per cent) and highest for stage IV disease (27 per cent). <p>Multidisciplinary team meeting</p> <ul style="list-style-type: none"> In 2015 the statewide average for documented MDM discussions for colorectal cancer patients was 79 per cent, ranging from 56 to 93 per cent across ICS. Thirty-two per cent of rectal cancer patients had a documented MDM after treatment had started. <p>Treatment</p> <ul style="list-style-type: none"> There was significant variation in overall utilisation of surgery, chemotherapy and radiotherapy in colon and rectal cancer patients across Victoria between 2011 and 2015. <p>Palliative care</p> <ul style="list-style-type: none"> Ten per cent of colorectal cancer patients received chemotherapy within 30 days of their death. For sixty-eight per cent of colorectal cancer patients, their place of death was a Victorian hospital. 	<ul style="list-style-type: none"> SMICS - Patients with rectal cancer living in the SMICS region have lower survival rates. Sixty-four per cent of rectal cancer patients had an MDM discussion occur after treatment. WCMICS - Fifty-five per cent of colon cancer (stage III) patients who had surgery are achieving timely adjuvant chemotherapy (within 56 days). BSWRICS - There is significantly lower utilisation of chemotherapy compared with the state average for colorectal cancer patients (stages I/II/III). GRICS - Fifteen per cent of colorectal cancer patients living in GRICS have surgery in an emergency admission. Fifty per cent of rectal cancer patients had no MDM discussion. HRICS - There is a significantly lower proportion of colon cancer surgery (stages II/III) with 12+ lymph nodes examined (Victorian hospitals only) compared to Victorian average. LMICS - Stage IV colon cancer survival is significantly lower for residents of LMICS compared with the Victorian average. GICS - Rectal cancer (stages I/II/III) patients are significantly less likely to receive neoadjuvant radiotherapy compared with the Victorian average.

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