The varying role of the GP in the pathway between colonoscopy and surgery for colorectal cancer: a retrospective cohort study

David Goldsbury,[1] Mark Harris,[2] Shane Pascoe,[2] Michael Barton,[3] Ian Olver,[4] Allan Spigelman,[5] Justin Beilby,[6] Craig Veitch,[7] David Weller,[8] Dianne L O'Connell[1]

For numbered affiliations see end of article.

Correspondence to
David Goldsbury;
davidg@nswcc.org.au

ABSTRACT

Objectives: To describe general practitioner (GP) involvement in the treatment referral pathway for colorectal cancer (CRC) patients.

Design: A retrospective cohort analysis of linked data.

Setting: A population-based sample of CRC patients diagnosed from August 2004 to December 2007 in New South Wales, Australia, using the 45 and Up Study, cancer registry diagnosis records, inpatient hospital records and Medicare claims records.

Participants: 407 CRC patients who had a colonoscopy followed by surgery.

Primary outcome measures: Patterns of GP consultations between colonoscopy and surgery (ie, between diagnosis and treatment). We investigated whether consulting a GP presurgery was associated with time to surgery, postsurgical GP consultations or rectal cancer cases having surgery in a centre with radiotherapy facilities.

Results: Of the 407 patients, 43% (n=175) had at least one GP consultation between colonoscopy and surgery. The median time from colonoscopy to surgery was 27 days for those with an intervening GP consultation and 15 days for those without the consultation. 55% (n=223) had a GP consultation up to 30 days postsurgery; it was more common in cases of patients who consulted a GP presurgery than for those who did not (65% and 47%, respectively, adjusted OR 2.71, 95% CI 1.50 to 4.89, p=0.001). Of the 142 rectal cancer cases, 23% (n=33) had their surgery in a centre with radiotherapy facilities, with no difference between those who did and did not consult a GP presurgery (21% and 25% respectively, adjusted OR 0.84, 95% CI 0.27 to 2.63, p=0.76).

Conclusions: Consulting a GP between colonoscopy and surgery was associated with a longer interval between diagnosis and treatment, and with further GP consultations postsurgery, but for rectal cancer cases it was not associated with treatment in a centre with radiotherapy facilities. GPs might require a more defined and systematic approach to CRC management.

ARTICLE SUMMARY

Article focus

- Primary healthcare providers have an important contribution to make in the process of colorectal cancer management. However, in Australia, the extent of GP involvement remains unknown as does their level of influence on the treatment referral pathway.
- We investigated the key patient clinical and demographic characteristics associated with consulting a GP between colonoscopy and surgery (ie, between diagnosis and treatment), for patients with colorectal cancer in New South Wales, Australia.
- We also investigated whether consulting a GP leading up to colorectal cancer surgery was associated with time between colonoscopy and surgery, consulting a GP after surgery or place of treatment for rectal cancer cases.

Key messages

- Less than half (43%) of the patients who had a colonoscopy and surgery consulted a GP between the procedures; consulting a GP was associated with poorer health.
- Those who consulted a GP presurgery had longer time between colonoscopy and surgery and more commonly consulted a GP postsurgery, but rectal cancer cases were no more likely to have treatment in a centre with radiotherapy facilities.
- A more well-defined approach to CRC management by GPs might be required.

Strengths and limitations of this study

- A relatively large population-based sample of patients, with reliable information on GP consultations and surgical treatment for both public and private hospitals.
- We could not assess other treatment types and we did not have data on specific GP recommendations or physician specialties.

BACKGROUND

Primary healthcare providers have an important contribution to make in the process of colorectal cancer (CRC) management. General Practitioners (GPs) refer a majority of patients with symptoms or positive screening tests for a diagnostic colonoscopy.[1] Following diagnosis, GPs may continue to be involved in decision-making around definitive treatment and then subsequently during treatment, as well as in providing psychological support and management of comorbidities and side effects of cancer treatment.[2–6] The coordination of care during this process is difficult for patients and health professionals, given the number and complexity of the services involved.[7] Little is known about the extent of primary healthcare worker involvement in or their level of influence on the treatment referral pathway.

A patient may take one of multiple pathways prior and subsequent to diagnosis,[8] and the lack of a clear referral pathway[9] may increase the time to treatment. Referrals are most frequently made to surgeons, followed by gastroenterologists and oncologists.[10] In addition, patients often move back and forth between services.[11][12] In Australia, GPs refer patients for diagnostic colonoscopy and can be involved in the patient's subsequent decision to have treatment and post-treatment follow-up. However, little is known about the actual level of GP involvement in this pathway, which now also includes referral of patients who come into the referral pathway through the National Bowel Cancer Screening Program. In the programme, people turning 50, 55 or 65 are screened using a faecal occult blood test (FOBT), and those with a positive result are sent to their GP who refers them for further investigations.[13] The relationship between the GP and the referral specialist may also be an important factor in determining the ongoing role of the GP during and after treatment.[14] One study reported that the greater use of primary care prediagnosis is associated with better CRC outcomes,[15] although it is a complex relationship that varies across cancer types.[16]

Despite the availability of clinical guidelines,[17] many CRC patients do not receive optimal care.[18][19] The choices GPs make about referral of patients in certain health systems can have profound effects on patient outcomes.[20] A European study reported that 1-year cancer survival was lower in health systems where the GP acted as a 'gatekeeper'.[21] Furthermore, a recent systematic review found a significant relationship between hospital case volume and short-term mortality for cancer surgery patients.[22] However, inconsistent results mean that the relative importance of surgeon/hospital volume remains unclear, clouding the appropriateness of using case volume alone.[22] Nevertheless, treatment in a multidisciplinary cancer centre with radiotherapy facilities is important for patient care, especially for rectal cancer cases.[23–26]

The aim of this study was to use linked population-based data to describe GP involvement in the referral pathway after diagnosis for CRC in New South Wales (NSW), Australia. This is one part of a four-phase study that also includes an audit of surgeons' referral letters and focus groups with clinicians and patients relating to the treatment referral pathway.[14][27][28] In this phase, we sought to determine whether there is an opportunity for GP involvement in patient care, as evidenced by GP consultations in the period between diagnosis and admission for surgery. We were also interested in whether presurgical GP consultations were associated with time to surgery, postsurgical GP consultations or, among rectal cancer cases, having surgery in a centre with radiotherapy facilities.

METHODS

Data sources

The data sources and linkage process for this study have been described in detail elsewhere.[27] Briefly, we used linked records from the population-based 45 and Up Study,[29] the NSW Central Cancer Registry (CCR), the NSW Admitted Patient Data Collection (APDC) and claims for medical services from Medicare Australia. The 45 and Up Study is a cohort study of 266 000 NSW residents aged 45 years or more, sampled from the Medicare Australia registration database.[29] Participants completed baseline questionnaires between January 2006 and May 2008 and consented to linkage to the other data collections used here. CCR records were obtained for people diagnosed with CRC between January 2001 and December 2007, along with APDC hospital separation records from July 2000 to June 2008 and claims for medical services through the Medicare Benefits Scheme (MBS) between June 2004 and January 2009.

Probabilistic linkage between the 45 and Up Study, the CCR and the APDC was done by the Centre for Health Record Linkage,[30] as described previously, resulting in approximately 0.1% false-positive and <0.1% false-negative linkages.[27] MBS claims records were linked by the Sax Institute using encrypted Medicare identification numbers. Ethical approvals for the 45 and Up Study, this specific study and the linkage were given by the University of NSW Human Research Ethics Committee and the NSW Population and Health Services Research Ethics Committee. The provision of Medicare records was approved by the Department of Health and Ageing Ethics Committee.

The group of interest comprised the 45 and Up Study participants who were diagnosed with CRC and had a colonoscopy leading up to their diagnosis as well as surgical treatment after diagnosis. Included cases were diagnosed from August 2004 to December 2007 and were linked with the APDC and MBS, so all cases had records for treatments and consultations at least 2 months prior to and at least 6 months after diagnosis.

The CCR provided data regarding the month and year of diagnosis, age, place of residence at diagnosis, disease

stage (localised, regional, distant metastases or unknown) and cancer site (colon, or rectum including the rectosigmoid junction). We identified patients' comorbidities from APDC diagnosis codes, including cardiovascular disease, chronic obstructive pulmonary disease (COPD), diabetes and other diseases in the Charlson Comorbidity Index (other key comorbidities).[31] Other sociodemographic characteristics (in table 1) were obtained from the self-completed 45 and Up Study baseline questionnaire.

Procedures and consultations

A specialist clinical panel identified relevant procedure codes and items for consultations, colonoscopies and surgery in the APDC and MBS. GP consultations were indicated by MBS items 1–51, 601–603, 700–719, 5000–5067 and 10 996–10 997. Surgical treatment comprised hemicolectomies, total colectomies, partial colectomies, total proctocolectomies, anterior rectal resections, Hartmann's procedure (rectosigmoidectomy), abdominoperineal resections and 'other' resections of the colon or rectum. Previous studies have shown that these data sources record over 90% of colonoscopies and surgical treatments for patients with cancer.[32] [33] Chemotherapy and radiotherapy are generally performed on an outpatient basis, for which data were not available, so they were not included in this study.

Diagnosis dates were available as month and year only, so chronology around diagnosis was based on calendar month and year. However, we were able to analyse the actual dates of GP consultations from the MBS and colonoscopies and surgeries from the APDC and MBS. We included surgical procedures performed in or after the month of diagnosis, and the last presurgery colonoscopy no earlier than 2 months prior to the month of diagnosis. For GP consultations occurring between colonoscopy and surgery, only consultations from the day of colonoscopy and at least 2 days prior to surgery were considered, to allow for the consultation to have an impact on the treatment pathway and to exclude consultations that were most likely for preoperative checks.

Outcomes

The primary outcome was the pattern of GP consultations between colonoscopy and surgery. This was then used as the key study factor in examining time between colonoscopy and surgery, patterns of GP consultations following surgery and, for rectal cancer cases, receiving surgery in a centre with radiotherapy facilities.

Statistical analysis

χ^2 tests were used to compare patient groups and unconditional multivariable logistic regression identified factors associated with the outcomes of interest. Cox's proportional hazards regression was used to investigate factors associated with time between colonoscopy and surgery. Factors of interest included patient characteristics such as age, disease stage and place of residence.

Consultation of a GP between diagnosis and treatment was analysed for associations with time to surgery, having a GP consultation after surgery and, for rectal cancer cases, having treatment in a centre with radiotherapy facilities. Having a specialist consultation was considered a possible confounder and was included as a covariate. A small number of patients with missing values for variables of interest were excluded from analyses. All analyses were carried out in SAS V.9.1 (SAS Institute Inc, Cary, North Carolina, USA).

RESULTS

The study sample has been described in detail elsewhere.[27] Briefly, 1023 CRC cases diagnosed between January 2001 and December 2007 were identified from the CCR among the first 102 938 participants in the 45 and Up Study. The sample was restricted to 569 CRC cases diagnosed from August 2004 to December 2007 whose identifiers linked to the APDC and MBS. Of these, 407 cases (72%) received surgery in or after the month of diagnosis and had a previous colonoscopy (up to 2 months before the month of diagnosis) (figure 1). These 407 cases are the ones in whose GP consultations we were interested; their characteristics are described in table 1.

GP consultations between diagnosis and treatment

Forty-three per cent (n=175) of the 407 cases had at least one GP consultation between diagnosis and treatment (figure 2), with 23% having one consultation, 10% having two consultations and 9% having three or more consultations during that period. There were higher odds of consulting a GP between diagnosis and treatment for those who consulted a specialist prior to surgery, along with those reporting poorer health, those with diabetes, those without COPD, ever smokers and those who were diagnosed with CRC after participating in the 45 and Up Study (table 1).

Time between diagnosis and treatment

The median time from colonoscopy to surgery was 19 days; it was 27 days for those with and 15 days for those without an intervening GP consultation (figure 2). The time to surgery was more than 28 days for 43% of cases consulting a GP compared to 15% of patients who did not consult a GP. For those consulting a GP, the median time from colonoscopy to the first GP consultation was 7 days, and the median time of the last consultation prior to surgery was 10 days (including multiple GP consultations, excluding those 1 or 2 days presurgery). After adjusting for all covariates, the time from diagnosis to treatment remained significantly longer for patients who consulted a GP between diagnosis and treatment than for those who did not. This was also true for those who consulted a specialist between diagnosis and treatment compared with those who did not, and for rectal cancer cases compared with colon cancer

Table 1 Characteristics of colorectal cancer (CRC) cases diagnosed between August 2004 and December 2007 that had colonoscopy and surgery, and characteristics associated with consulting a GP between colonoscopy and surgery (N=407)

Category	n	GP consult n	Per cent	Adjusted OR*	95% CI*	p Value†
Sex						0.79
Woman	152	64	42	1.10	0.56 to 2.15	
Man	255	111	44	1.00	(ref)	
Age						0.77
<60	78	28	36	1.38	0.58 to 3.30	
60–69	108	42	39	1.13	0.57 to 2.28	
70–79	150	75	50	1.00	(ref)	
80+	71	30	42	1.50	0.62 to 3.65	
Country of birth						0.09
Australia	320	141	44	1.00	(ref)	
Other	81	30	37	0.50	0.22 to 1.12	
Unknown	6	4	67	Not incl.	Not incl.	
Language spoken at home						0.41
English	377	163	43	1.00	(ref)	
Non-English	30	12	40	0.59	0.17 to 2.06	
Place of residence at diagnosis						0.62
Metropolitan	186	75	40	1.00	(ref)	
Other urban	103	45	44	0.63	0.24 to 1.62	
Rural	118	55	47	1.65	0.58 to 4.69	
Type of housing						0.93
House	296	130	44	1.00	(ref)	
Flat/unit	50	19	38	1.17	0.46 to 2.93	
House on farm	28	12	43	1.22	0.40 to 3.66	
Elderly accommodation	26	11	42	0.79	0.24 to 2.58	
Other/unspecified	7	3	43	Not incl.	Not incl.	
Socioeconomic status						0.27
Least disadvantaged quintile	143	54	38	1.00	(ref)	
Quintile 2	64	28	44	1.65	0.58 to 4.69	
Quintile 3	126	55	44	1.17	0.43 to 3.21	
Quintile 4	58	28	48	2.40	0.87 to 6.60	
Most disadvantaged quintile	16	10	63	3.18	0.63 to 16.01	
Highest education level attained						0.27
No school certificate/other	48	22	46	1.20	0.47 to 3.09	
School/intermediate certificate	102	41	40	1.00	(ref)	
Higher school/leaving certificate	28	12	43	1.49	0.47 to 4.67	
Trade/apprenticeship	56	21	38	1.01	0.40 to 2.55	
Certificate/diploma	83	36	43	1.47	0.63 to 3.43	
University degree or higher	80	37	46	2.94	1.19 to 7.26	
Unspecified	10	6	60	Not incl.	Not incl.	
Marital status						0.08
Married/living as married	288	120	42	1.00	(ref)	
Single/divorced/separated	51	28	55	2.65	1.11 to 6.30	
Widowed	65	26	40	1.03	0.44 to 2.39	
Unspecified	3	1	33	Not incl.	Not incl.	
Income level						0.11
<$20K p.a.	112	51	46	1.00	(ref)	
$20K–<$40K p.a.	83	45	54	1.79	0.76 to 4.25	
$40K–<$70K p.a.	62	22	35	0.68	0.26 to 1.75	
$70K+ p.a.	52	15	29	0.56	0.19 to 1.68	
Unspecified	98	42	43	0.74	0.33 to 1.67	
Health insurance						0.19
Private with extras	190	83	44	1.00	(ref)	
Private no extras	70	26	37	0.45	0.21 to 0.97	
DVA/healthcare card	101	46	46	1.20	0.55 to 2.62	
None of these	37	16	43	0.67	0.24 to 1.85	
Missing	9	4	44	1.24	0.24 to 6.47	

Continued

Table 1 Continued

Category	n	GP consult n	Per cent	Adjusted OR*	95% CI*	p Value†
BMI‡						0.21
Underweight/normal (<25 kg/m²)	155	59	38	1.00	(ref)	
Overweight (25–≤30 kg/m²)	157	69	44	1.56	0.83 to 2.93	
Obese/morbidly obese (≥30 kg/m²)	66	31	47	1.30	0.58 to 2.94	
Null/not specified	29	16	55	2.93	0.98 to 8.74	
Smoking status						0.05
Never smoker	203	80	39	1.00	(ref)	
Ever smoker	204	95	47	1.81	1.01 to 3.26	
Self-reported health status						0.002
Good–excellent	307	115	37	1.00	(ref)	
Fair/poor	78	47	60	2.76	1.30 to 5.82	
Unspecified	22	13	59	5.60	1.59 to 19.81	
Cardiovascular disease						0.11
Yes	47	26	55	2.09	0.85 to 5.13	
No	360	149	41	1.00	(ref)	
COPD						0.04
Yes	29	10	34	0.30	0.09 to 0.95	
No	378	165	44	1.00	(ref)	
Diabetes						0.001
Yes	50	33	66	5.15	2.02 to 13.16	
No	357	142	40	1.00	(ref)	
Other key comorbidities						0.88
Yes	56	26	46	0.94	0.40 to 2.18	
No	351	149	42	1.00	(ref)	
Family history of CRC						0.51
Yes	75	37	49	1.27	0.63 to 2.57	
No	332	138	42	1.00	(ref)	
Disease stage						0.08
Localised	185	73	39	1.00	(ref)	
Regional	176	76	43	1.66	0.91 to 3.02	
Distant metastases	27	13	48	1.57	0.47 to 5.19	
Unknown	19	13	68	5.05	1.35 to 18.91	
Cancer site						0.52
Colon	265	114	43	1.00	(ref)	
Rectum	142	61	43	1.21	0.68 to 2.18	
Year of diagnosis						0.64
2004	43	17	40	1.24	0.46 to 3.36	
2005	113	43	38	0.93	0.44 to 1.93	
2006	111	56	50	1.46	0.72 to 2.95	
2007	140	59	42	1.00	(ref)	
Timing of CRC diagnosis relative to the 45 and Up Study questionnaire						0.01
Before (prevalent)	327	131	40	0.35	0.16 to 0.75	
After (incident)	80	44	55	1.00	(ref)	
Specialist consultation between colonoscopy and surgery						<0.0001
Yes	285	156	55	17.64	7.71 to 40.34	
No	122	19	16	1.00	(ref)	

*Adjusted for all other variables in this table.
†Overall p value from a multivariable logistic regression.
‡Calculated from self-reported weight (kg)/height (m)².
BMI, body mass index; CRC, colorectal cancer; COPD, chronic obstructive pulmonary disease; DVA, Department of Veterans' Affairs; GP, general practitioner; Not incl.: this category was not included in logistic regression (n=26 overall); Ref: reference category.

cases (table 2). Separate analyses for colon and rectal cancer cases found that for both cancer types there was a longer time to surgery for those consulting a GP or a specialist between diagnosis and treatment (table 3).

GP consultations after treatment

Twenty-six per cent (26%, n=106) of cases had a GP consultation up to 2 weeks postsurgery, 55% (n=223) consulted a GP up to 30 days postsurgery and 80% (n=327) consulted a GP up to 3 months postsurgery. After
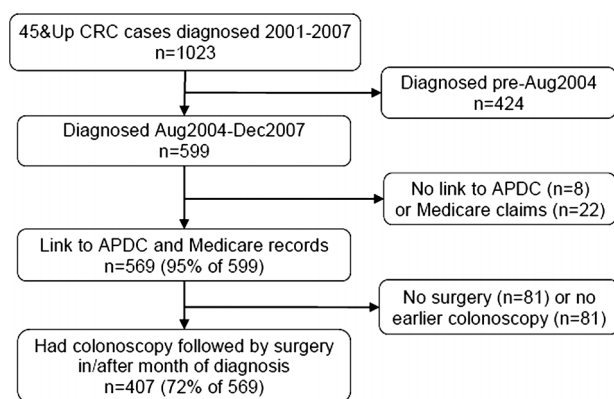
Figure 1 Selection of cases with colorectal cancer for analysis.

adjusting for all covariates, patients who consulted a GP in the interval between diagnosis and treatment were more likely to consult a GP in the 30 days postsurgery (65% vs 47% for those not consulting a GP presurgery, OR 2.71, 95% CI 1.50 to 4.89, p=0.001).

Rectal cancer surgery in a centre with radiotherapy facilities

Of the 142 rectal cancer cases, 23% (n=33) had their surgery in a centre with radiotherapy facilities, 21% of those with and 25% of those without a presurgery GP consultation. After adjusting for key characteristics, there was no association between consulting a GP presurgery and having the surgery in a centre with radiotherapy facilities (OR 0.84 vs no presurgical GP consultation, 95% CI 0.64 to 2.35, p=0.54). An additional 21% had their surgery in a hospital colocated with a centre that had radiotherapy facilities, and a further 8% had a non-surgical admission to a centre with radiotherapy facilities within the study period.
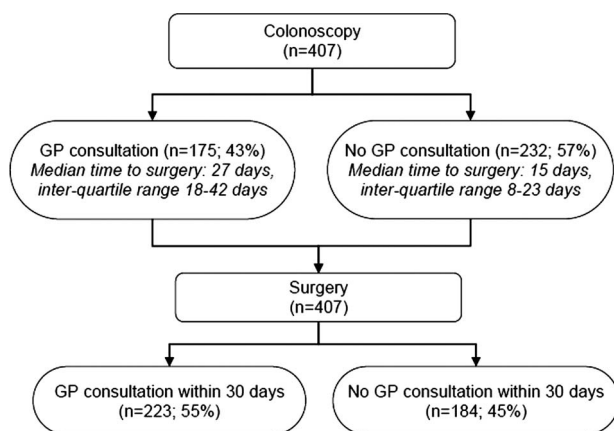

Figure 2 Flowchart of procedures and consultations for the 407 colorectal cancer cases who had a colonoscopy and surgery.

DISCUSSION

Around two in five newly-diagnosed CRC cases who had colonoscopy and surgery had a GP consultation between diagnosis and treatment, potentially allowing the GP to have some influence on individual patient treatment pathways. Having a GP consultation during this period was associated with longer time to surgery (but not necessarily causally) and consulting a GP postsurgery, but for rectal cancer cases it was not associated with treatment in a centre with radiotherapy facilities.

Having a GP consultation between diagnosis and treatment was more likely for cases with poorer self-reported health, those with diabetes, those without COPD and those who had ever been a smoker. Almost half of the patients who consulted a GP between diagnosis and treatment had more than one consultation during this time period. This suggests that GP consultations may be occurring for the most appropriate group: coordinating the care of those patients at higher risk because of poor general health.

The time from colonoscopy to surgery was substantially longer (a difference in medians of 12 days) for patients who consulted a GP between diagnosis and treatment, even after adjustment for cancer site, comorbidities, disadvantage and health status. However, we were unable to determine whether there was a causal link between GP consultations and time to surgery; it may be that a longer time period simply allows a greater opportunity for GP consultations in the interval. It could also be due to more patients who consulted a GP having presurgical radiotherapy. If increased time to surgery was a consequence of the engagement of the GP, this may have allowed a more considered decision by the GP about the optimal referral pathway with the increased interval being unlikely to have a material influence on the physical outcome, although it may raise psychological issues for the patient.[34 35] It is worth considering if there are other ways in which GPs could be involved in decisions regarding care following diagnosis that do not increase the interval between diagnosis and treatment. This might include arranging follow-up GP visits sooner after the colonoscopy, especially as the first GP consultation was a median of 7 days afterwards. It might also include earlier email, text or telephone communication between the GP and the patient to initiate a referral.

Having a GP consultation after surgery was more likely for patients who consulted a GP in the lead-up to surgery, suggesting a greater continuity of primary care for these cases. Again, this might be especially appropriate for those who had comorbidities or poorer health status. It might also assist lower socioeconomic patients who, because of poorer health literacy, may have had more difficulty navigating the complexities of the health-care system.

Given the importance of being able to offer radiotherapy for rectal cancer,[17] we investigated any potential association between presurgical GP consultations and

Table 2 Demographic and clinical characteristics associated with time between colonoscopy and colorectal cancer (CRC) surgery for all CRC cases (N=407)

Category	n	Median time (days)	IQR (days)	Adjusted HR*	95% CI*	p Value†
GP consultation between colonoscopy and surgery						<0.0001
Yes	175	27	18–42	0.44	0.34 to 0.58	
No	232	15	8–23	1.00	(ref)	
Specialist consultation between colonoscopy and surgery						0.002
Yes	285	21	14–35	0.62	0.47 to 0.84	
No	122	13	7–22	1.00	(ref)	
Sex						0.53
Woman	152	19	12–28	1.10	0.82 to 1.46	
Man	255	20	12–31	1.00	(ref)	
Age						0.33
<60	78	17	8–29	0.78	0.54 to 1.13	
60–69	108	19	13–32	0.80	0.59 to 1.09	
70–79	150	21	12–29	1.00	(ref)	
80+	71	20	12–28	1.05	0.73 to 1.52	
Country of birth						0.34
Australia	320	19	13–29	1.00	(ref)	
Other	81	19	8–30	0.85	0.61 to 1.19	
Unknown	6	12	10–40	Not incl.	Not incl.	
Language spoken at home						0.20
English	377	19	12–29	1.00	(ref)	
Non-English	30	21	10–38	1.40	0.84 to 2.31	
Place of residence at diagnosis						0.95
Metropolitan	186	19	11–28	1.00	(ref)	
Other urban	103	20	13–28	1.07	0.71 to 1.63	
Rural	118	20	11–33	1.04	0.69 to 1.57	
Type of housing						0.63
House	296	19	12–29	1.00	(ref)	
Flat/unit	50	19	10–29	0.93	0.64 to 1.35	
House on farm	28	21	12–48	0.76	0.48 to 1.20	
Elderly accommodation	26	22	17–42	0.86	0.53 to 1.40	
Other/unspecified	7	29	19–31	Not incl.	Not incl.	
Socioeconomic status						0.13
Least disadvantaged quintile	143	17	11–28	1.00	(ref)	
Quintile 2	64	20	12–34	0.94	0.60 to 1.46	
Quintile 3	126	20	8–29	1.24	0.80 to 1.92	
Quintile 4	58	22	14–33	0.82	0.53 to 1.26	
Most disadvantaged quintile	16	22	14–27	1.60	0.80 to 3.19	
Highest education level attained						0.53
No school certificate/other	48	20	14–31	1.09	0.74 to 1.60	
School/intermediate certificate	102	22	16–33	1.00	(ref)	
Higher school/leaving certificate	28	18	12–34	0.96	0.59 to 1.56	
Trade/apprenticeship	56	18	13–28	1.36	0.92 to 2.00	
Certificate/diploma	83	20	10–29	0.94	0.68 to 1.32	
University degree or higher	80	16	8–36	1.16	0.80 to 1.70	
Unspecified	10	13	3–22	Not incl.	Not incl.	
Marital status						0.09
Married/living as married	288	24	12–37	1.00	(ref)	
Single/divorced/separated	51	18	11–28	1.04	0.72 to 1.52	
Widowed	65	22	17–34	0.69	0.48 to 0.97	
Unspecified	3	20	9–21	Not incl.	Not incl.	
Income level						0.11
<$20K p.a.	112	21	14–31	1.00	(ref)	
$20K–<$40K p.a.	83	21	13–31	1.03	0.71 to 1.49	
$40K–<$70K p.a.	62	18	9–35	0.83	0.56 to 1.23	
$70K+ p.a.	52	13	8–29	1.50	0.95 to 2.35	
Unspecified	98	19	13–28	1.19	0.85 to 1.66	

Table 2 Continued

Category	n	Median time (days)	IQR (days)	Adjusted HR*	95% CI*	p Value†
Health insurance						0.42
Private with extras	190	18	9–28	1.00	(ref)	
Private no extras	70	17	11–28	1.01	0.73 to 1.40	
DVA/healthcare card	101	21	14–29	0.90	0.66 to 1.24	
None of these	37	28	19–41	0.67	0.44 to 1.03	
Missing	9	25	16–28	1.09	0.51 to 2.33	
BMI‡						0.48
Underweight/normal (<25kg/m^2)	155	18	10–28	1.00	(ref)	
Overweight (25–<30 kg/m^2)	157	20	12–35	0.86	0.66 to 1.13	
Obese/morbidly obese (≥30 kg/m^2)	66	22	13–31	0.95	0.68 to 1.34	
Null/Not specified	29	19	11–29	0.72	0.45 to 1.15	
Smoking status						0.33
Never smoker	203	19	10–29	1.00	(ref)	
Ever smoker	204	19	12–30	1.13	0.89 to 1.44	
Self-reported health status						0.37
Good–excellent	307	18	11–29	1.00	(ref)	
Fair/poor	78	21	15–40	0.89	0.64 to 1.23	
Unspecified	22	22	14–28	0.70	0.41 to 1.21	
Cardiovascular disease						0.77
Yes	47	20	9–29	0.95	0.65 to 1.38	
No	360	19	12–30	1.00	(ref)	
COPD						0.47
Yes	29	20	11–27	1.19	0.74 to 1.92	
No	378	19	12–30	1.00	(ref)	
Diabetes						0.18
Yes	50	26	14–36	1.30	0.89 to 1.90	
No	357	19	11–29	1.00	(ref)	
Other key comorbidities						0.67
Yes	56	20	12–29	1.08	0.76 to 1.52	
No	351	19	12–30	1.00	(ref)	
Family history of CRC						0.99
Yes	75	20	13–33	1.00	0.75 to 1.34	
No	332	19	12–29	1.00	(ref)	
Disease stage						0.08
Localised	185	19	13–29	1.00	(ref)	
Regional spread	176	19	10–29	1.16	0.91 to 1.48	
Distant metastases	27	20	12–39	0.73	0.43 to 1.21	
Unknown	19	35	13–48	0.65	0.37 to 1.16	
Cancer site						<0.0001
Colon	265	18	10–27	1.00	(ref)	
Rectum	142	22	14–37	0.58	0.45 to 0.74	
Year of diagnosis						0.53
2004	43	19	9–26	1.32	0.86 to 2.02	
2005	113	19	12–29	1.01	0.75 to 1.37	
2006	111	21	14–32	1.13	0.84 to 1.52	
2007	140	18	11–32	1.00	(ref)	
Timing of CRC diagnosis relative to the 45 and Up questionnaire						0.61
Before (prevalent)	327	19	11–29	1.09	0.79 to 1.50	
After (incident)	80	21	14–31	1.00	(ref)	

*Adjusted for all other variables in this table (HR<1 indicates longer time between colonoscopy and surgery).
†Overall p Value from the Cox proportional hazards regression.
‡Calculated from self-reported weight (kg)/height (m)^2.
BMI, body mass index; CRC, colorectal cancer; DVA, Department of Veterans' Affairs; GP, general practitioner; COPD, chronic obstructive pulmonary disease; IQR, interquartile range; Not incl.: this category was not included in proportional hazards regression (n=26 overall); ref: reference category.

surgery in hospitals with radiotherapy facilities, reflecting another aspect of continuity of care. For rectal cancer cases, having a GP consultation prior to surgery was not associated with having a surgical procedure in a centre with radiotherapy facilities. Fewer than one in four had their surgery in a centre with radiotherapy facilities, although this increased to around one in two when allowing for surgery in hospitals colocated with

Table 3 Demographic and clinical characteristics associated with time between colonoscopy and colorectal cancer surgery, for colon and rectum cancer cases

Category	Colon cancer (n=265)			Rectal cancer (n=142)		
	Adjusted HR*	95% CI	p Value†	Adjusted HR*	95% CI	p Value†
GP consultation between colonoscopy and surgery			0.001			<0.0001
Yes	0.54	0.38 to 0.79		0.25	0.13 to 0.48	
No	1.00	(ref)		1.00	(ref)	
Specialist consultation between colonoscopy and surgery			0.01			0.01
Yes	0.57	0.38 to 0.86		0.41	0.21 to 0.79	
No	1.00	(ref)		1.00	(ref)	
Country of birth‡			0.36			0.01
Australia	1.00	(ref)		1.00	(ref)	
Other	1.22	0.80 to 1.87		0.37	0.17 to 0.78	
Marital status‡			0.28			0.02
Married/living as married	1.00	(ref)		1.00	(ref)	
Single/divorced/separated	0.92	0.54 to 1.58		1.52	0.70 to 3.26	
Widowed	0.68	0.42 to 1.10		0.42	0.20 to 0.86	
Income level			0.13			0.03
<$20K p.a.	1.00	(ref)		1.00	(ref)	
$20K–<$40K p.a.	0.78	0.46 to 1.31		0.65	0.32 to 1.33	
$40K–<$70K p.a.	0.85	0.50 to 1.44		0.30	0.12 to 0.75	
$70K+ p.a.	1.62	0.88 to 2.99		0.52	0.19 to 1.41	
Unspecified	0.91	0.58 to 1.42		1.07	0.52 to 2.21	
Health insurance			0.02			0.01
Private with extras	1.00	(ref)		1.00	(ref)	
Private no extras	0.67	0.43 to 1.04		1.71	0.88 to 3.33	
DVA/healthcare card	0.54	0.36 to 0.80		3.36	1.56 to 7.24	
None of these	0.51	0.27 to 0.95		0.79	0.35 to 1.78	
Missing	0.46	0.14 to 1.58		2.09	0.63 to 6.99	
Disease stage			0.02			0.72
Localised	1.00	(ref)		1.00	(ref)	
Regional spread	1.17	0.85 to 1.62		0.79	0.48 to 1.30	
Distant metastases	0.66	0.35 to 1.25		0.60	0.18 to 2.01	
Unknown	0.43	0.21 to 0.89		1.13	0.29 to 4.38	

*Adjusted for all other variables in this table, as well as for sex, age, language spoken at home, place of residence at diagnosis, type of housing, socioeconomic status, education level, BMI, smoking status, self-reported health status, comorbidities, family history of colorectal cancer, year of diagnosis and diagnosis before/after completing study questionnaire. The variables not shown in the table were not associated with time to surgery for colon or rectal cancers. HR<1 indicates longer time between colonoscopy and surgery.
†Overall p Value from the Cox proportional hazards regression.
‡Excludes missing values (n=6 for country of birth, n=3 for marital status, n=9 overall).
MBI, body mass index; GP, general practitioner; DVA, Department of Veterans' Affairs; Ref: reference category.

another hospital that has a radiotherapy centre. Others have previously reported the potential underutilisation of specialist cancer centres for patients with rectal cancer.[25 26]

This study is subject to a number of limitations. The 45 and Up Study had a response rate of 18% (similar to other cohort studies of this nature) and oversampled people from rural areas. While the 45 and Up Study participants resemble the general population in many respects, they are in general of higher socioeconomic status and more 'healthy'.[36] However, empirical data from the study show risk estimates relating to a wide range of exposures and outcomes in the cohort are very similar to those calculated using 'representative' population survey data.[36] We did not include treatment with chemotherapy or with radiotherapy as the available data were not comprehensive for all people receiving these

treatments, and nor did we have information on patients' decisions regarding treatment. These may have influenced the place of treatment and explained some of the differences in the time to surgery. We analysed rectal cancer surgery in hospitals with radiotherapy facilities as an indicator that all cancer treatment modalities were available at one centre, thereby making it a more comprehensive cancer facility. This could have been improved with information regarding patients' decisions, GPs' recommendations and the specialties of all physicians involved in the care of each patient.

It is difficult to sort out the cause and effect of GP visits and an increased interval between diagnosis and treatment using these data alone as the Medicare data do not identify the reasons for GP visits. It may have been in relation to CRC or some other preexisting illness. Similarly, we could not determine the nature of

specialist consultations, and a longer time to surgery for those with a specialist consultation could be beneficial if it means patients are getting the most appropriate treatment. Furthermore, we did not have information on individual physicians or their specialties, so we could not assess other aspects potentially related to the referral pathway, such as whether the colonoscopy was performed by a gastroenterologist or a surgeon, or whether the same surgeon then carried out the surgical procedure.

The National Bowel Cancer Screening Program was started in August 2006,[13] but this study does not fully address what happens in the presence of the screening programme. In this programme, a GP refers a patient to colonoscopy after a positive FOBT result and is then involved in the referral process for cases diagnosed with CRC. The programme is being expanded to include people in other age groups,[13] giving a further opportunity for GP involvement. This means that there is some urgency to optimise the potential benefits of engagement of GPs (eg, in providing better guidance about where to refer), and a need to address the potential reasons for an increased interval between diagnosis and treatment associated with consulting a GP, especially for patients with rectal cancer.

Conclusion

This is one of the first studies to examine the role of the GP in the pathway following CRC diagnosis and prior to surgery. Less than half of the patients had a GP consultation in this period, but those who did appeared to be among those who most needed it. The association between consulting a GP pretreatment and posttreatment is a strong rationale for GP engagement in the early stages of the patient pathway and will improve long-term continuity of care. Further research is needed to explore the directions of the association between GP visits and the interval between diagnosis and treatment. However, a more systematic approach might be needed for GP involvement in the treatment pathway, perhaps including official guidelines from primary care/GP organisations. This would not only encourage GP involvement, but it would also ensure that this does not lead to unnecessary delays.

Author affiliations
[1]Cancer Research Division, Cancer Council NSW, Sydney, New South Wales, Australia
[2]UNSW Research Centre for Primary Health Care and Equity, Sydney, New South Wales, Australia
[3]Liverpool Health Service, Collaboration for Cancer Outcomes Research & Evaluation, Sydney, New South Wales, Australia
[4]Cancer Council Australia, Sydney, New South Wales, Australia
[5]UNSW St Vincent's Clinical School, Sydney, New South Wales, Australia
[6]Faculty of Health Sciences, University of Adelaide, Adelaide, New South Wales, Australia
[7]Faculty of Health Sciences, University of Sydney, Sydney, New South Wales, Australia
[8]Centre for Population Health Services, University of Edinburgh, Edinburgh, Scotland

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