The PIPER Project

An Internal Examination of Colorectal Cancer Management in New Zealand

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Prepared for:

Health Research Council and Ministry of Health

Final report 7th August 2015

Health Research Council Reference: 11/764

Ethical Approval Number: MEC/12/EXP/022

Acknowledgements

The project team would like to sincerely thank the regional Data Managers for their tremendous efforts to collect the data: Reenu Arora, Kelly Bargh, Jennifer Cameron, Aishwarya Gupta, Keerthana Kamath, Glenys Mahoney, Debbie Skinner, Liz Thompson and Katy Wiessing. We would also like to sincerely thank Jerome Macapagal for design, development and maintenance of the project database. We would like to acknowledge and thank the medical records staff across New Zealand hospitals and private practice staff who facilitated access to medical records, and the Ministry of Health Analytical Services team for the support with accessing data from National data sets. Finally we would like to thank everyone who helped in the review and preparation of this report, especially Lindsey Wylde.

Executive Summary

Background

Colorectal Cancer (CRC) is a major cause of morbidity and mortality in New Zealand (NZ), with 3030 new diagnoses and 1191 deaths reported in 2011.[1] The report "Unequal Impact II: Māori and Non-Māori Cancer Statistics by Deprivation and Rural-Urban Status" found that rural residents were less likely to be diagnosed with CRC, but were more likely to die of the disease.[2] Additionally, differences according to ethnicity are apparent.[2] Māori have lower rates of CRC than non-Māori, however there are differences in treatments received and outcomes by ethnicity that are incompletely accounted for by stage at presentation.[3] To date, little information has been available about incidence, treatment or outcome for people of Pacific ethnicities.

In response to a Ministry of Health (MoH) and Health Research Council of NZ (HRC) Request For Proposals (RFP) to support a project that would "examine bowel cancer from presentation, to diagnosis, through to management and include treatment outcomes" including reporting on "variations across NZ…to gain a greater understanding of the local context", we undertook the PIPER Project (Presentations, Investigations, Pathways, Evaluation, Rx [treatment]) from 2011. We detail actual patient presentation, diagnosis, treatment and management data for a national cohort of CRC patients, including description of variations resulting from differences in ethnicity, location of residence and socioeconomic status.

We brought together a research team and advisory group with expertise in population health, general practice, rural health, medical and radiation oncology, general and specialist surgery, Māori and Pacific health, health management, as well as academic biostatisticians, health research staff and patient representatives.

Methods

We undertook a national retrospective cohort study of all NZ residents diagnosed with colorectal adenocarcinoma in NZ from 1 Jan 2007 – 31 Dec 2008. We included an extended cohort of all Māori and Pacific diagnosed 1 Jan 2006 - 31 Dec 2006 and 1 Jan 2009 – 31 Dec 2009, and a randomly sampled equal number of non-Māori non-Pacific (nMnP) cases over those same time frames, to enable adequate explanatory power.

A list of key performance indicators (KPIs) based on national and international guidelines were identified by the project Investigators and Advisory Group members as being the most likely indicators to capture quality of care across the various components of management of CRC. Several iterations were reviewed and a final version agreed upon. Data extraction from this initial list was undertaken for a pilot period of 4 months and timeliness of data collection and quality of data extracted (by means of proportion missing data for each field) was reviewed on the first 226 cases collected. On the basis of this review a final fields list was created and approved. Data for the study was collected from public and private medical records from across the country.

The main outcome measures were proportions of patients meeting KPIs relating to patient presentation, management, treatment and follow-up according to rurality, ethnicity or socio-economic deprivation. In this report we present crude proportions that are not adjusted for age or gender. Thus comparisons between groups should be interpreted carefully, bearing in mind the associations between

patient and clinical characteristics outlined below. Comprehensive modelling to account for age, gender, disease stage, co-morbidity and other modifiers of outcome will be undertaken using the data generated from this study and published in academic peer reviewed journals. Once updated survival data is available, papers examining the relationship between KPIs and survival will be published.

Results

We hand-searched the medical records of 6387 patients, resulting in 5667 eligible patients. The process of data collection took over 9,000 hours. Over 960,000 individual data points were entered onto a sophisticated, purpose built database housed at Cancer Trials New Zealand (CTNZ). The pilot phase identified the following data fields that had missing data for greater than 25% of cases: age of family member with malignancy, ECOG performance status, planned duration of chemotherapy and response to chemotherapy.

Patient characteristics

Overall, 4193 (74%) were diagnosed with colon cancer, 1401 (25%) with rectal cancer. Site of tumour was collected preferentially from operation note (where available), and tumours denoted as rectosigmoid were grouped in colon cancer. Distance of tumour from anal verge was not documented clearly enough in the cohort to denote rectal location as upper, middle or lower. The site of the primary CRC was unknown for 73 (1%).

Of the patients with CRC, 8% were recorded as Māori (either within the medical record or on the NZ Cancer Registry (NZCR)), 3% as Pacific, and 2% as Asian. The proportions of Māori and Pacific CRC patients with rectal cancer (versus colon cancer) were 30 and 41% respectively, and the proportions of European and Asian CRC patients with rectal cancer were 24 and 26% respectively. The proportion of male CRC patients who had rectal cancer (versus colon) was almost twice as high as the proportion in females.

The proportion of colon cancers that were right sided (located proximal to the splenic flexure) was 51% and the proportion that were left sided (located at or distal to the splenic flexure) was 48%; sidedness was unknown for 1%. Females were more likely to have a right sided colonic tumour (57%); males were more likely to have a left sided tumour (54%). Our findings confirm the previously reported right to left shift in colon cancer[4] and the previously observed male: female imbalance in sidedness. Site of primary tumour is relevant to epidemiologists and policy makers when considering different screening methods for colorectal cancer, and may also be relevant to tumour prognosis and chemotherapy response.[5] There were no clear differences in cancer site by deprivation score, rurality of place of residence at diagnosis or distance from the health facility where their CRC was diagnosed.

The distribution of age at diagnosis differed by ethnicity, with Māori patients tending to be younger than nMnP patients. Pacific had a larger proportion under 60 at diagnosis than either Māori or nMnP. These population groups have different age structures from the nMnP population which needs to be considered, and this will be investigated in on-going analyses.

Comparison of ethnicity to deprivation, rurality, and distance of residence from health facility of diagnosis demonstrated strong relationships; these will need to be taken into account in order to understand patterns of care. A higher proportion of Māori and Pacific patients were living in deprived areas compared to nMnP patients. The proportions in quintile 9-10 (the most deprived) were: Māori

41%; Pacific 45% and nMnP 14%. There was also a strong association between rurality and NZ Deprivation Index of residence at diagnosis. This is not a linear relationship from most urban to most rural, but a peak in deprivation was noted for independent urban areas: the areas with the greatest deprivation were the independent urban areas. These areas include "towns and settlements without significant dependence on main urban centres. Independent urban communities are urban areas (other than main urban areas) where less than 20 percent of the usually resident employed population's workplace address is in a main urban area e.g. Westport".[6] The proportions in the highest quintile of deprivation (9-10) were: independent urban 26%; urban 18% and rural 8%.

Presentation to hospital care, and staging

Colon cancer

The mode of first presentation was to the emergency department (ED) for 34% of patients with colon cancer as, compared with 44% for Māori and 51% for Pacific patients. In the UK, 21% of CRC patients have this mode of admission. [7] In PIPER, 22% of patients with colon cancer presented with obstruction; the proportion was highest for independent-urban patients (28%).

The department of First Specialist Assessment (FSA) was surgical for 60% of patients with colon cancer and gastroenterology for 25% of patients. There was a statistically significant association between the department of FSA and distance to health facility of diagnosis, with those living 10-20km from health facility of diagnosis being most likely to present to gastroenterology. This may be linked to the size of the hospital where the FSA was undertaken, and the influence of facility of diagnosis on this finding will be investigated in further planned analyses.

Less than half the patients were completely staged, as defined by the presence of key diagnostic procedures. Completion colonoscopy was achieved either pre-operatively or within a year of diagnosis 61% of the time. The initial source of pathological confirmation of cancer was colonoscopy for 57% of patients.

Rectal cancer

The mode of first presentation was to the ED for 14% of patients with rectal cancer, compared with 21% for Māori and 24% for Pacific patients. 8% of patients presented with obstruction.

The department of First Specialist Assessment (FSA) was surgical for 67% of patients with rectal cancer and gastroenterology for 26% of patients.. There was a statistically significant association between department of FSA and rurality, with those living in independent urban areas being most likely to present to a surgical department. Again as for colon cancer this may be linked to size of the hospital where the FSA was undertaken and will be further investigated.

Pre-treatment stage was not clearly documented for the majority of patients with rectal cancer, and so was categorised as "localised/regionally advanced" (non-metastatic) and "metastatic". Only a third of patients were completely staged as defined by the presence of key diagnostic procedures. Completion colonoscopy was achieved either pre-operatively or within a year of diagnosis in 62% of patients. The initial source of pathological confirmation of cancer was colonoscopy for 63% of patients.

Stage at diagnosis

Colon Cancer

Stage I: 12%

Stage II: 27%

Stage III: 25%

Stage IV: 24%

Non-metastatic, unable to be further defined: 5%

Unknown: 7%

Rectal Cancer

Non-metastatic (stage I-III): 76%

Stage IV: 19%

Unknown: 5%

The stage of CRC at diagnosis is the single most powerful prognostic variable, and is the principal determinant of treatment. NZ has a relatively higher proportion of patients diagnosed with stage IV (metastatic) disease than other countries, Australia has 19% and 17% stage IV for colon and rectal cancer respectively, and the UK 17% for both stage IV colon and rectal.[8] Higher proportions of metastatic disease were seen in Māori and Pacific patients: the proportions diagnosed with stage IV colon cancer being 32% and 35% for Māori and Pacific respectively, and for rectal cancer being 29% and 22% respectively. The stage distribution seen in NZ is that of an unscreened population, with the lowest proportion of cancers being stage I. Results from population screening trials demonstrate that the proportion of stage I CRC increases by 4-6% when screening is introduced, some areas having up to 18% stage I cancers.[9] Although there was no clear pattern in stage at diagnosis by deprivation, it is noted that those in the group with most deprivation (Dep9-10) were least likely to be diagnosed with stage I disease.

Treatment

Non-metastatic colon cancer

Resection of primary disease was undertaken in 95% of patients with non-metastatic colon cancer. From this operation 90 day post-operative mortality was 5%, anastomotic leak rate was 4% and unplanned return to theatre rate was 6%. Definition and consistent reporting of anastomotic leak is challenging, and the proportion identified in this study is double what has recently been reported in the Colorectal Surgical Society of Australia and New Zealand (CSSANZ) Bi-National Colorectal Cancer Audit (BCCA) across Australia and NZ.[10] However, this audit involved voluntary submission of data limited to participating centres and combined Australian and NZ data, thus it is likely that the proportion we report is a more accurate reflection of the overall NZ cohort during the timeframe of the study.

Examination of 12 or more lymph nodes was not recorded in pathology reports for a third of patients. Again this contrasts with the BCCA which found a median lymph node harvest of 15 nodes retrieved for colon cancer cases reported voluntarily to BCCA database between 2007 and 2014. Only 56% of pathology reports in our cohort were in synoptic (structured) form, written to include key prognostic information.

Of the patients with resected stage III colon cancer, 59% received adjuvant chemotherapy. Less than half of the treated patients completed 24 weeks of the initially prescribed adjuvant therapy.

Non-metastatic rectal cancer

Radiotherapy (RT) was received by 52% of patients with non-metastatic rectal cancer. Of the pre-operative strategies, 18% received short course and 82% received long-course. 10% of patients who received radiotherapy were treated post-operatively rather than pre-operatively.

Resection of primary disease was undertaken in 92% patients with non-metastatic rectal cancer. From this operation 90 day mortality was 3%. Anastomotic leak rate was difficult to identify with accuracy. Unplanned return to theatre rate was 8%.

Examination of 12 or more lymph nodes was recorded in pathology report for 49% of patients. 51% of pathology reports were in synoptic (structured) form, written to include key prognostic information. Mesorectal grading information was missing in 65% of reports. Distance to circumferential resection margin (CRM) was unknown for 37% of cases.

Adjuvant chemotherapy was received by 36% of patients with non-metastatic rectal cancer. Again completion of 24 weeks of initially prescribed chemotherapy was low – 47% of patients who had received pre-operative chemotherapy received at least 18 weeks of adjuvant chemotherapy and 41% of patients who did not receive pre-operative chemotherapy completed 24 weeks of initially prescribed adjuvant therapy.

Metastatic colorectal cancer

Resection of primary disease was undertaken in 52% of patients with stage IV disease; the proportions who had a resection of their primary disease were slightly higher in rural vs. urban (55% vs. 45%) patients. Most patients who had not had their primary removed did not have stoma (83%).

Overall 7% of patients had liver resection and 1% of patients had lung resection with no clear differences by ethnicity, distance or rurality but patients residing in NZDep Index 1-2 (least deprived) vs. 9-10 (most deprived) regions had a greater rate of liver resection.

Overall only 49% of patients with stage IV CRC received chemotherapy. There were no clear trends in proportion of patients receiving chemotherapy by ethnicity however these proportions were not adjusted by age or comorbidity therefore potential important findings may be discovered with later planned analyses. Un-adjusted proportions suggested that rural patients with metastatic CRC were more likely to receive chemotherapy than urban patients.

Multidisciplinary Meeting (MDM) Discussion

Overall two-thirds of CRC patients had no evidence of discussion at an MDM at any stage in their treatment. In the UK, during a similar time frame 82% of CRC cases were discussed at an MDM. [11] In our study non-metastatic rectal cancer had the highest proportion discussed at an MDM (42%), followed by metastatic CRC (24%) followed by non-metastatic colon cancer (15%). Data from the BBCA audit suggests 51% of submitted rectal cancer cases were discussed at an MDM (from 2007-2014).[10]

Conclusions

1. **High rates of emergency presentation**

   Over a third of patients with colon cancer presented to the ED, considerably in excess of the UK (21%). Further work is needed to better understand the pathway leading to diagnosis. This was not within the scope of the project.

2. **A high proportion of NZ patients are diagnosed with metastatic disease**

   The proportion of patients diagnosed with metastatic colon (24%) and rectal (19%) cancer in NZ is higher than in the UK (17% for both) and Australia (19% and 17% respectively) and is particularly high for Māori and Pacific patients (32% and 35% respectively for colon cancer). The implementation of a screening programme has the potential to shift stage at diagnosis. Again further work investigating the pathway leading to diagnosis is warranted.

3. **Improvements in pathology reporting are necessary**

   Just over half of the pathology reports reviewed for this study were in synoptic (structured) format. The Royal College of Pathologists of Australasia have undertaken significant work on developing structured and synoptic reporting since 2009. Universal structured/synoptic reporting would greatly assist quality national data collection.

4. **Chemotherapy intervention rates appear lower than expected**

   Less than 50% of patients with stage IV disease received chemotherapy, which is known to prolong survival. Barriers to receiving chemotherapy for stage IV disease require attention. Proportions receiving chemotherapy in non-metastatic CRC are also lower than expected.

5. **MDM discussion was low for this cohort**

   Our rates of documentation of MDM discussion were very low compared to international standards. Patients with non-metastatic rectal cancer were most likely to be discussed (42%) whilst across the same time frame 82% of all CRC cases were discussed in the UK.

The PIPER project is the most comprehensive colorectal dataset ever assembled in NZ, covering public and private sectors. It sets a foundation for future quality improvement initiatives and identifies several areas of research priority.

Areas for future consideration

- **The interaction between comorbidity, treatment and outcome requires careful consideration**

  Comorbidity appears to influence the proportion of patients receiving intervention. Future analyses of the PIPER dataset are planned to understand the relationship between comorbidity, ethnicity, deprivation, rurality, treatment received and outcomes. This will help inform the design of relevant future interventional and observational studies.

- **A high proportion of patients are elderly, and the optimal treatment paradigm for this group is unclear**

  Interventional studies are needed in this area which will be well informed by further examination of the PIPER dataset for this age group.

- **Prospectively collected national data with quality assurance and coverage of private providers is needed to assist ongoing monitoring of quality service delivery**

  Standardised definitions are required and a minimum data set requires delineation. Such a data collection process would improve the capture of key fields that were abandoned during the pilot phase due to poor documentation. We anticipate that some data elements will need to be entered and captured manually, possibly expanding on the work of the Colorectal Surgical Society of ANZ dataset. Greater detail regarding non-surgical cancer care treatment and toxicity is also required.

- **Genomic correlation with clinical outcome data may yield valuable additional information**
  The integration of genomics and prognostic signatures with this dataset could provide an internationally valuable resource.

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List of Abbreviations

5FU	5-Flurouracil
CRC	Colorectal Cancer
CSSANZ	Colorectal Surgical Society of Australia and New Zealand
CT	Computerised Tomography
DHB	District Health Board
DI	Deprivation Index
ECOG	Eastern Cooperative Oncology Group performance status
ED	Emergency Department
FSA	First Specialist Assessment
GP	General Practitioner
HRC	Health Research Council
KPS	Karnofsky Performance Status
MDM	Multidisciplinary Meeting
MI	Myocardial Infarction
MO	Medical Oncology
MOH	Ministry of Health
MRI	Magnetic Resonance Imagine
nMnP	non-Māori non-Pacific
NSAID	Nonsteroidal Anti-Inflammatory
NZ	New Zealand
PE	Pulmonary Embolism
RFP	Request for Proposals
RO	Radiation Oncology
UK NBoCa	UK National Bowel Cancer

1 Background

Colorectal cancer (CRC) is a major cause of death and morbidity worldwide with over 1.2 million cases diagnosed annually.[12] In New Zealand (NZ) it is the most commonly diagnosed cancer (excluding non-melanoma skin cancers) and second leading cause of cancer-related death, with 3030 new diagnoses and 1191 deaths recorded on the NZ Cancer Registry and NZ Mortality Collection respectively in 2011.[1]

It has been estimated by GLOBOCAN that in 2012 NZ and Australia had the highest incidence of CRC in the world (ASR 44.8 and 32.2 per 100,000 in men and women respectively, Figure).[13] The GLOBOCAN project provides estimates of the incidence, mortality and prevalence of major types of cancer for 184 countries of the world.

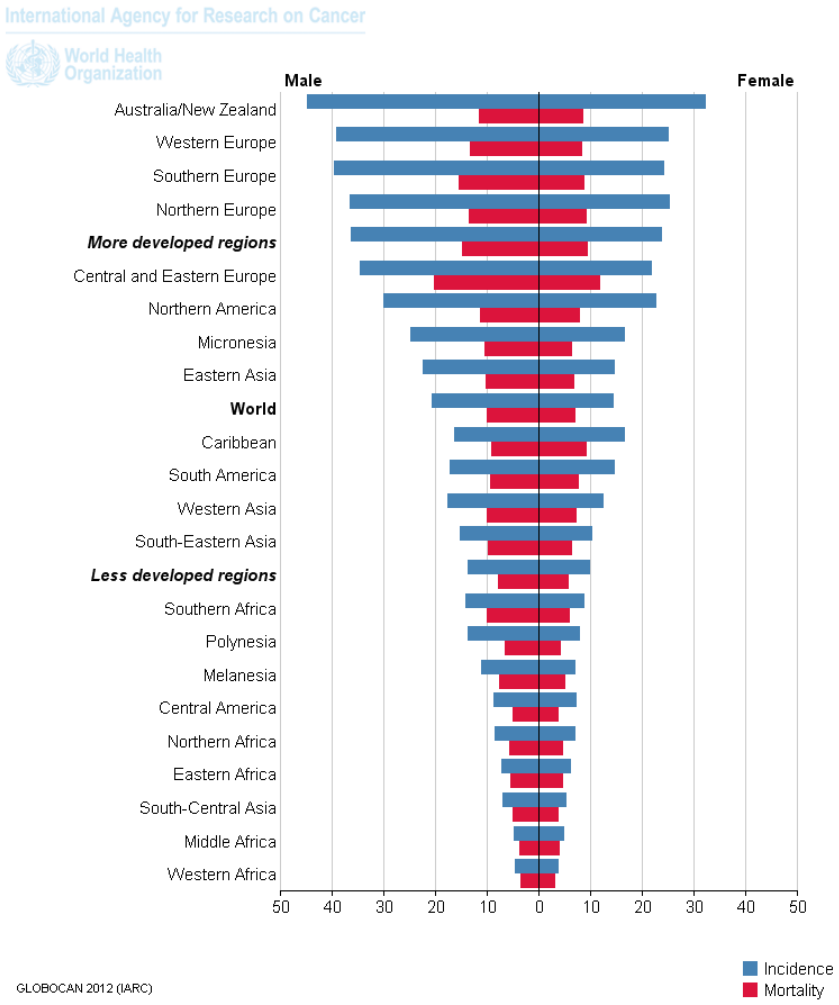

Figure 2.1-1 Globocan 2012 estimated age-standardised rates (World) per 100,000 of CRC incidence and mortality.

Alongside a high incidence, NZ also has higher death rates for CRC compared to Australia. A recent analysis estimated there was a 35% excess mortality for NZ women and 24% for NZ men compared to Australia for CRC.[14] The explanation for this is not yet apparent, however significant advances in treatment of CRC have been achieved worldwide, and differential implementation of such advances into practice in NZ as compared to other countries may contribute to this mortality excess. There is currently no published information available on the current standards of care delivered to patients

throughout NZ, or how they compare to international best practice. A previous international comparison of 17 countries (including Australia but not including NZ) found evidence of variations in management practices and 5 year survival between countries.[15] The 5 year survival figures reported in the study for Australia and the United States of America (USA) were higher than the figures previously reported for the NZ population.[15, 16]

Inequitable access to treatment advances across patient groups may also play a key role. Previous research undertaken in NZ has shown disparities in mortality relating to geographical location of residence (urban-rural status),ethnicity, and socio-economic status.[2, 17] These disparities were shown to be independent of disease stage at diagnosis, suggesting there is variation in management occurring post diagnosis.[2, 17]

In NZ, less than 20% of the population live in rural areas.[6] The report from the Ministry of Health "Unequal Impact II: Māori and Non-Māori Cancer Statistics by Deprivation and Rural-Urban Status" investigated variations in cancer incidence, mortality, stage at diagnosis, and survival by rural-urban status from 2002-2006.[2] They found that although residents of rural areas were less likely to be diagnosed with CRC, they were more likely to die of the disease.[2] They found no significant difference in stage at diagnosis between urban and rural patients.[2]

CRC is one of the only cancers where Māori have lower registration and mortality rates than non-Māori.[1] However this difference is reducing with time.[1] A detailed review of Māori and Non-Māori cancer trends is provided by the Ministry of Health (MOH) report "Unequal Impact: Māori and Non-Māori Cancer Statistics 1996-2001".[17] The report agrees that non-Māori are more likely to be diagnosed with CRC than Māori, however, once diagnosed, Māori are more likely to die of the disease.[17] This disparity is partially explained by significant differences in stage at diagnosis; however within stage disparities in survival remain significant.[17] Previous work in NZ has suggested that despite lower rates of CRC, there are significant differences in treatments received and outcomes by ethnicity.[18] In a cohort study of all Māori diagnosed with CRC between 1996 and 2003, along with an equal number of randomly selected non-Māori cases, Māori were less likely to be referred for chemotherapy, likely to wait longer, and less likely to be offered and then receive adjuvant and palliative chemotherapy. Furthermore, Māori were more likely to have emergency surgery and a stoma. These findings persisted after adjusting for patient characteristics such as comorbidity.[18] Sample size limitations preclude reliable conclusions for rectal cancer.[19]

Pacific people are a disparate population that have followed a pattern of migration to NZ mainly over the past century. Proportionately Pacific people account for 7.4% of the NZ population, a total of approximately 295,000 people.[20] Increasingly people who identify with at least one Pacific ethnicity are born in NZ (62.3%), with the majority of all Pacific people living in the Auckland (65.9%), and Wellington regions (12.2%).[20] Like Māori, Pacific people have traditionally had a lower incidence of CRC, approximately 50% lower than that of European/Other.[21] During 2011 there were 76 Pacific registrations of CRC, comprising 9.4% of all Pacific cancer registrations and 2.5% of the annual CRC NZ incidence,[1] both proportions increasing from 2010 at 7.5% and 1.95%[22] and 2009 at 7.6% and 2.0%, respectively.[23] The age of Pacific patients at registration was generally lower than nMnP and incidence dropped off at approximately 60 years. This is suggested to be due to a lower age at mortality.[24]

Also like Māori, Pacific people tend to have worse outcomes once they have a CRC diagnosis, with increasing cancer specific mortality trends both nationally[20] and internationally.[25] Reasons for

disparities between Pacific and nMnP groups have been linked to stage at presentation,[24, 25] poorer treatment at diagnosis,[25] comorbidities[24] and inequality between Māori/Pacific and nMnP groups.[20] Treatment can also vary; Pacific patients have been shown to be less likely to go undergo primary resection due to their presenting stage (e.g. stage IV disease).[24]

Pacific people are more likely to be identified within the lowest socioeconomic groups (SES)[26, 27] where cancer incidence is shown to be highest.[26] Those in the lowest SES groups have been found to be less likely to participate in screening programmes and to have lifestyles with more cancer risk factors e.g., more likely to smoke (28% v 11%) and be obese (66%v 56%) than those in higher SES groups.[26] For Māori and Pacific SES had an adverse effect on cancer mortality.[26]

A study of 132,006 New Zealanders who had a cancer registration between 1994 and 2003 showed socioeconomic status (SES) was adversely associated with survival in multiple cancer types, including CRC.[28] These findings were over and above the influence of disease stage at diagnosis, and were also independent of ethnic inequities in SES.[28] The authors hypothesised that health risk behaviours such as smoking, comorbidity, or disease characteristics could indirectly contribute to inequities according to SES.

Because of the high incidence and mortality of CRC in NZ, the Ministry of Health has made CRC a priority cancer. A National Bowel Cancer Work group has been formed, a Bowel Screening pilot has been established and is due to complete in 2015, national direct-access colonoscopy guidelines have been produced, and provisional standards of service provision for bowel cancer have been developed. In 2010 a request for proposals (RFP) was released by the MOH and Health Research Council of NZ (HRC) to support a project that would "examine bowel cancer from presentation, to diagnosis, through to management and include treatment outcomes" including reporting on "variations across NZ… to gain a greater understanding of the local context". This current project was the result of this RFP and was funded for a 3 year period in 2011 by a MOH and HRC partnership grant. We detail actual patient presentation, diagnosis, treatment and management data for a national cohort of CRC patients, including description of variations resulting from differences in ethnicity, location and socioeconomic status.

2 Project Objectives and Structure

2.1 Project Objectives

1. To compare progression free survival in patients diagnosed with colon and rectal adenocarcinoma (CRC) according to:
    a. location of residence
        i. urban or rural
        ii. distance from treating centre
    b. Ethnicity
    c. Socio-economic deprivation of area of residence

2. To identify differences in patient presentation, management, treatment and follow-up which contribute to differences in outcome by rurality, ethnicity or socio-economic deprivation

2.2 Project Structure

This project was developed in response to an RFP released by the HRC in 2010 by the PIPER Investigators listed in Table 2.2-1. Prior to submission of the RFP, review and support of the proposed project was sought and received from all four NZ regional Cancer Networks, and the NZ consumer advocacy group Bowel Cancer NZ (formerly known as Beat Bowel Cancer Aotearoa).

Oversight of the project from RFP proposal to completion was provided by a wider Advisory Group, as listed in Table 2.2-2.

Conduct of the project was managed by CTNZ. Subcontracts were set in place to allow localised collection of data from the six Regional Cancer Centres (RCC's): Auckland and Northland, Waikato, Mid-Central, Capital and Coast, Canterbury and Southland.

The project was funded from October 2011 – October 2014 by an HRC-MOH partnership grant.

The report presents the first phase of our analysis, which addresses objective 2. The second phase of our analysis continues, and is separately funded. In the second phase we will:

1. Compare survival and progression free survival by rurality, ethnicity and deprivation adjusting for patient and disease characteristics at presentation. We will obtain updated data on survival from the Ministry of Health in order to maximize information.
2. Further evaluate the key aspects of management as identified in phase one, in order to:
    a. identify differences in patient management by rurality, ethnicity and deprivation which are not explained by measured demographic and disease characteristics;
    b. to investigate the correlations between rurality, ethnicity and deprivation and the impact of these on differences in management;
    c. investigate the extent to which the identified management factors can explain differences in outcomes by ethnicity, rurality and socio-economic status.

Table 2.2-1 PIPER Investigators

Name	Project Role	Affiliations
Professor Michael Findlay	Principal Investigator	Professor of Oncology, University of Auckland (UoA) Director of Research and Consultant Medical Oncologist , Blood and Cancer Service, Auckland District Health Board (DHB) Director, Cancer Trials New Zealand (CTNZ)
Dr Christopher Jackson	Project Lead	Consultant Medical Oncologist , Southern DHB Senior Lecturer in Medicine, Department of Medicine, Dunedin School of Medicine, University of Otago Chair, South Island Bowel Cancer Working Group and member, National Bowel Cancer Working Group Clinical Advisor, CTNZ
Mrs Melissa Firth	Project Manager	Clinical Research Coordinator, CTNZ
Associate Professor Katrina Sharples	Lead Biostatistician	Associate Professor of Biostatistics, Department of Medicine, Dunedin School of Medicine, and Department of Mathematics and Statistics, University of Otago Principal Biostatistician, CTNZ
Professor Ross Lawrenson	Co-Investigator	Assistant Dean and Professor, Clinical, Waikato Clinical School, UoA
Associate Professor Papaarangi Reid	Co-Investigator	Tūmuaki, Te Kupenga Hauora Māori, UoA
Mr John Keating	Co-Investigator	Consultant Colorectal Surgeon, Wellington Hospital, Capital and Coast DHB
Mr Adrian Secker	Co-Investigator	Consultant General Surgeon, Nelson Hospital, Nelson-Marlborough DHB
Dr Mark Jeffrey	Co-Investigator	Consultant Medical Oncologist, Christchurch Hospital, Canterbury DHB
Ms Victoria Hinder	Biostatistician	Biostatistician, CTNZ

Table 2.2-2 PIPER Advisors

Name	Affiliations
Professor Andrew Hill	Professor of Surgery, Assistant Dean and Head of the South Auckland Clinical Campus, UoA Clinical Lead Research and Evaluation, Ko Awatea, Counties Manukau Health Colorectal surgeon Counties-Manukau DHB
Associate Professor Diana Sarfati	Associate Professor and Co-Head of Department, Department of Public Health, University of Otago, Wellington
Associate Professor Sarah Derrett	Director of Health, Disability and Rehabilitation Studies School of Public Health, Massey University Former Chairperson, Bowel Cancer New Zealand (formerly known as Beat Bowel Cancer Aotearoa)
Associate Professor Wendy Stevens	Associate Professor, Rural Health and Research, University of Western Sydney (Prior) Principal Investigator HRC Lung Cancer Project, Northern Cancer Network
Dr Carol Atmore	General Practitioner, Chief Medical Officer West Coast DHB & Medical Director West Coast PHO
Dr Charles De Groot	Clinical Director, Midland Cancer Network & Radiation Oncologist Waikato DHB
Dr Dale Bramley	CEO Waitemata DHB
Dr Charis Brown	Project Manager, Midlands Prostate Cancer Study, UoA Waikato & Pacific Representative

3 Methods

3.1 The PIPER study population

The PIPER study included patients diagnosed with CRC in NZ over the calendar years 1 January 2006 - 31 December 2009. Potential cases were identified from the NZ Cancer Registry (NZCR; data extracted 17 May 2012) as having been diagnosed with ICD-10-AM codes C18-C20 during the relevant years.

Main cohort:

Patients diagnosed with CRC between 1 January 2007 and 1 January 2008. This time period was chosen as would provide a description of patterns of care which were recent enough to be relevant to current resource planning, and would also provide sufficient follow-up time (6-7 years).

Extended cohort:

This included all patients in the main cohort and also all Māori and Pacific patients diagnosed in the calendar years 1 January 2006 – 31 Dec 2006 and 1 Jan 2009 – 31 Dec 2009, and a randomly sampled equal number of nMnP cases diagnosed over the same time frame. Māori and Pacific cases were identified as having one of the following codes for level 2 prioritised ethnic code as listed at the time of extraction from the NZCR: 21 (NZ Māori), 30 (Pacific not further defined), 31 (Samoan), 32 (Cook Island Māori), 33 (Tongan), 34 (Niuean), 35 (Tokelauan), 36 (Fijian), 37 (Other Pacific Island). These potential cases were reviewed for eligibility and then an equal numbered sample of nMnP controls stratified by year of diagnosis and cancer centre region were selected and reviewed for eligibility until an equal number of extension cases and control cases had been reached.

3.1.1 Eligibility criteria

Patients were eligible for the PIPER study if they met the following criteria.

3.1.1.1 *Inclusion criteria*

- Site of primary disease must be colon or rectal;
- Pathology (if available) must be adenocarcinoma.

Note: Clinical diagnosis of CRC was accepted if the pathology was unclear or the patient had no biopsies or surgery as long as the patient was still managed as if they had colon or rectal cancer.

3.1.1.2 Exclusion criteria

- Squamous cell carcinoma (SCC), carcinoid tumour, neuroendocrine neoplasm (NEN, NET or NEC), pseudomyxomaperitonei, sarcoma, lymphoma;
- Patients whose date of diagnosis fell outside of the specified time periods;
- Patients whose diagnosis within the project time frame represented a recurrence of a previous CRC. Recurrent disease for the purposes of eligibility for this project refers to a diagnosis of recurrent tumour at the site of a previous tumour, at the anastomosis following previous surgical resection of a CRC, or new metastatic disease on the background of a previous CRC tumour. Any new tumour arising in the colon or rectum at a site apart from those listed was considered new primary disease;

- Patients who presented with CRC symptoms, was diagnosed, or received treatment for their primary disease outside of NZ;
- Patients who are not a NZ resident at the time of diagnosis.

3.2 PIPER data

3.2.1 Data sources

Data were obtained from three main sources: the patient's clinical records; national databases of hospitalisations and mortality; national data on NZ Deprivation Index and rurality for meshblocks of residence, and the GPS coordinates of mesh block centroids (for calculation of travel distances for disease diagnosis and management).

3.2.2 Data extraction from clinical records

A retrospective case-review from the first presentation to hospital care resulting in the diagnosis of CRC until current status at the time of case-review was undertaken for all eligible patients. Data were extracted from local hospital databases, patient electronic records and, where necessary (i.e. if information was missing), hard copy medical files. Data for patients treated in the private sector were collected from the private clinician's medical records if the clinician's written agreement was received. Data collection was regionalised to one of six Data Managers based on the DHB of domicile of the patient as per the NZCR data set. Regional Data Managers were employed by either a District Health Board (DHB) or tertiary education centre (the University of Auckland) and had a background in oncology nursing, radiation therapy, medicine or clinical trials. If the patient's NHI was not found at the centre closest to the patient's domicile or no relevant information was found within that region, a check against the National database of hospital admissions was undertaken to identify patients who may have been diagnosed or treated in regions other than their DHB of domicile. Data was extracted and either written onto a case report form and then entered into the project database, or entered directly into the project database (see Section 3.2.6), p32. "Unknown" refers to missing data i.e. all available information for the patient has been reviewed, and this information is was not available. The section below outlines each field that was collected including definitions and the key documents that were searched for the information.

3.2.3 Process of identification of data fields to be collected

A list of key performance indicators (KPIs) based on national and international guidelines were identified by the project's Co-Investigators and Advisory Group members as being the most likely indicators to capture quality of care across the various components of management of CRC during the concept development phase of the project. Once funding was secured a face-to-face meeting was held with the Co-Investigators and Advisory Group members to review the selected KPIs and create a draft list of data fields to be collected from patient medical records to enable calculation of the proportion of patients meeting each KPI. Several iterations were reviewed and a final version agreed upon by the group via teleconference. Data extraction from this initial list was undertaken for an initial pilot period of 4 months (including staggered starting of regional data collection) and timeliness of data collection and quality of data extracted (by means of proportion missing data for each field) was reviewed on the first 226 cases collected. On the basis of this review a final fields list was created and approved again via teleconference.

3.2.3.1 List of fields culled from the pilot phase due to high proportion of missing data

The following fields had greater than 10% missing data at the end of the pilot phase and thus were not included in the final data fields list:

Baseline Aspirin use	Evidence that the patient is on a regular dose of aspirin at the time of diagnosis (15% missing)
Baseline NSAID use	Evidence that the patient is on a regular dose of NSAID (non-steroidal anti-inflammatory) at the time of diagnosis (15% missing)
Age of family member	The age at which any family member with a past medical history of malignancy (other than skin lesions) was diagnosis (66% missing)
Chemotherapy stage of disease	Stage of disease prior to starting chemotherapy as recorded on Medical Oncology new patient clinical letter (15% missing)
Height	Height as recorded on the chemotherapy chart for cycle 1 (20% missing)
Weight	Weight as recorded on the chemotherapy chart for cycle 1 (13% missing)
ECOG status	Eastern Cooperative Oncology Group performance status as recorded prior to the first cycle of chemotherapy (on Medical Oncology new patient clinical letter or chemotherapy chart) (67% missing)
Planned duration	Planned duration of chemotherapy as documented by the medical oncologist in weeks (32% missing)
Response to chemotherapy	The best response to a particular line of chemotherapy as documented in medical oncology clinical letters or notes (32% missing)
Radiotherapy stage of disease	Stage of disease prior to starting radiotherapy as recorded on Radiation Oncology new patient clinical letter (24% missing)

3.2.4 List of data fields collected or calculated from patient medical records

3.2.4.1 Demographics and patient identification fields

The NHI, name, date of birth, gender and ethnicity for each patient were auto-populated into the PIPER database from the NZCR. Each patient was allocated a unique non-identifiable ID). Pre-populated ethnicity data was checked against the medical record and updated if additional ethnicity information was available preferentially from patient-completed registration forms or, if these were unavailable, as recorded on the hospital electronic system.

3.2.4.2 Presentation fields

Data fields on the electronic database as collected from patient notes

Method of referral:	The referral source for the first referral or presentation to secondary care that resulted in the diagnosis of CRC. If multiple referrals were made the oldest was collected (unless the referral was declined and sent back to the referring doctor). Categories included: i. Self-referral to Emergency Department (ED): includes a patient taking themselves to an ED, or being taken by a family member/member of the

	public (including admission via ambulance without a General Practitioner (GP) or Accident and Urgent Care service provider). ii. GP referral to ED/Acute admission: includes a GP referring the patient to the nearest hospital ED or acute registrar e.g. the GP phones the surgical registrar to arrange an acute admission or gives them a note to present to ED. iii. GP referral to hospital specialist: includes a GP referring to an outpatient department in secondary care (e.g. gastroenterology, surgery, general medicine, medical oncology (MO) etc.) or a private clinician in one of these specialities. iv. Other specialist referral to gastro, surgery, oncology: includes a referral from one department in secondary care to another e.g. the patient may be receiving treatment or undergoing a procedure for an unrelated medical condition and their current specialist refers their patient to one of the listed departments for symptoms potentially indicative of CRC.
Date of referral:	Date that the referral letter (for the field above) was written (typed or signed) or the date that the patient presented to ED for an acute admission.
Evidence of obstruction:	Whether or not an obstruction (blockage) of the colon and/or rectum was diagnosed that required clinical management as per the discharge summary at the time of presentation to secondary care (either in response to the above referral or subsequent acute presentation). This definition does not include tumours that obstruct the lumen or scope on colonoscopy.
Date of First Specialist Assessment (FSA):	The date that the patient was first seen by a health specialist in secondary care post the first referral. This could either be the FSA as a result of the first referral e.g. gastroenterology outpatient clinic following GP referral, or if the patient was on a waiting list post referral and presented acutely e.g. became obstructed the surgical review at admission was collected as the FSA, or the date of ED presentation
FSA Department:	The speciality of the health specialist undertaking the FSA.

Calculated fields used in the report

Emergency presentation to secondary care:

- Either Self-referral to Emergency Department (ED) or GP referral to ED/Acute admission based on the Method of Referral field above. All other methods are classified as non-emergency presentation.

3.2.4.3 Staging fields

Data fields on the electronic database as collected from patient notes

Initial diagnosis method:	The name of the procedure that was performed that led to the first pathological diagnosis of adenocarcinoma of the colon or rectum (or a clinical diagnosis in the absence of any pathology).
Date of initial diagnosis:	The date that the pathology was reported from the above procedure (or the date that the above procedure was undertaken in the absence of pathological

	diagnosis). Where pathology was unavailable prior to surgery to remove the primary (e.g. acute presentation or multiple biopsies not confirmatory for adenocarcinoma) the date of diagnosis will be after the date of surgery to remove primary.
Site of primary tumour:	The anatomical location of the primary tumour in the colon or rectum as per the operation report. If this was not available the site as documented on the anatomical pathology report was used. Location of rectal tumours as upper, middle or lower was initially collected however this information was very rarely clearly documented thus a decision was made to record the site as rectal with no further specification.
Synoptic pathology report:	The pathology report resulting from the resection of primary tumour was reviewed for key fields considered critical for clinical interpretation: T stage, N stage, total lymph node harvest and number of positive nodes, grade, vascular invasion, lymphatic invasion (lymphovascular invasion accepted) and resection margin status (R status or detail of proximal and distal resection margins for colon cases and proximal, distal and radial or circumferential for rectal cases). If all of these fields were present the report was considered to meet our criteria for synoptic reporting.
Post-op T stage:	Collected from the anatomical pathology report for the primary tumour. If the patient had more than one tumour the T-stage of the poorer prognosis tumour was collected (e.g. if the patient had a T4N0 tumour and T3N0 tumour then the first tumour was used and T stage was collected as T4. However if the patient had a T4N0 tumour and a T3N1 tumour then the T stage was collected as T3.)
Post-op N stage:	Collected from the anatomical pathology report for the primary tumour. If the patient had more than one lesion the N stage of the poorer prognosis tumour was collected (as described above).
Post-op M stage:	Collected from the anatomical pathology report for the primary tumour. This was most frequently MX unless a biopsy or removal or secondary occurred. If MX was not stated on the pathology report then this field was collected as unknown.
No. lymph nodes examined:	The number of lymph nodes that were examined by the pathologist as recorded on the anatomical pathology report or subsequent clinic letters post-surgical resection of the primary tumour (not applicable for early stage tumours resected via polypectomy only).
No. positive lymph nodes:	The number of lymph nodes that contain cancerous cells as reported in the anatomical pathology report or subsequent clinic letters post-surgical resection of the primary tumour (not applicable for early stage tumours resected via polypectomy only).
Lymphovascular invasion (LVI):	The presence of cancerous cells in either the blood vessels or lymphatic vessels as recorded on the pathology report. If this was reported as two separate variables (lymphatic invasion – L and vascular invasion – V) and either were present/ positive then the case was collected as being positive for LVI.
Tumour differentiation:	The histological grade or the differentiation as recorded on the anatomical pathology report. This includes the following options: • well-differentiated (low grade or grade 1), • moderately differentiated (intermediate grade or grade 2), • poorly differentiated (high grade or grade 3) or

	• undifferentiated (anaplastic or grade 4). If the grade was documented as between two descriptors e.g. moderate to poor the worst grade was collected (in this instance poor). If the report stated "mucinous" as the only descriptor this was collected as "poorly differentiated."
Distance of tumour to circumferential margin:	The distance of the tumour to circumferential margin as reported on the anatomical pathology report for the primary tumour was collected for all patients with rectal cancer. If this was not reported "unknown" was entered onto the database.
Mesorectal quality:	The mesorectal quality as reported on the anatomical pathology report for the primary tumour was collected for all patients with rectal cancer. If this was not reported "unknown" was entered onto the database.
Computed Tomography of abdomen/pelvis (CT abdo/pelvis):	The dates of all instances of CT abdo/pelvis that could be found reported in the patient's medical record were collected for each patient.
CT chest:	The dates of all instances of CT chest that could be found reported in the patient's medical record where collected for each patient.
Colonoscopy:	The dates of all colonoscopies reported as being received by the patient were collected.
Completeness of pre-op colonoscopy:	Colonoscopies occurring prior to surgical removal of primary were reviewed for completeness status based on the colonoscopy report (a complete colonoscopy is defined as passage of the scope to the ileoceacal valve). An overall evidence of complete colonoscopy yes/ no was collected per patient. I.e. If the patient has several colonoscopies and one was complete then the data was collected as yes for complete pre-op colonoscopy.
Sigmoidoscopy:	The dates of all sigmoidoscopies reported as being received by the patient were collected.

Calculated fields used in the report

Site of cancer

- Colon: Caecum, ascending colon, hepatic flexure, transverse colon, splenic flexure, descending colon sigmoid colon, colon-unknown
- Rectal: Rectum
-

Tumour location:

- Right side: Caecum, Ascending colon, Hepatic flexure, Transverse colon
- Left side: Splenic flexure, Descending colon, Sigmoid colon, Recto-sigmoid

Stage:

- Pre-operative stage:
  - Classified as either non-metastatic or metastatic based on clinician's summary assessment and treatment intent at first treatment (usually surgery).
- Post-surgical stage:
  - Included information from the pathology report, so pathologic T and N stage and clinical M stage were used.

- Stage for adjuvant therapy:
  - The stage that would normally be available by 8 weeks post-surgery for post-op clinical review or medical oncology FSA. The classification of Stage IV includes any metastatic disease found on CT scans within 8 weeks after surgery for resection of the primary tumour. No other change is made to stage I,II or III.

Imaging:

Figures presented in the tables include all CTs scans of the abdomen/pelvis, chest or MRI of the pelvis, that were taken either within 8 weeks before surgery for resection of the primary tumour or up to 8 weeks after resection.

Colonoscopy:

We included any complete colonoscopy within 6 months before surgery for resection of the primary tumour, plus any colonoscopy up to 1 year after surgery.

Completeness of staging:

- Colon cancer stage I-III: CT of abdomen/pelvis within 8 weeks before surgery (plus 8 weeks after surgery for patients presenting acutely), complete colonoscopy within 6 months before surgery or any colonoscopy up to 1 year after surgery.
- Colon cancer stage IV: CT of abdomen/pelvis and chest, timing as above.
- Rectal cancer stage I-III: MRI of pelvis, CT of abdomen, colonoscopy, timing as above.
- Rectal cancer stage IV: CT of abdomen/pelvis and chest, timing as above.

3.2.4.4 Treatment fields

Data fields on the electronic database as collected from patient notes

Not for active treatment:	Whether or not the patient a decision was made that the patient would not receive any surgical, chemotherapeutic or radiotherapeutic interventions (including palliative treatments by these specialities, the decision being made either by medical team or patient choice).
Date of decision not for active treatment:	The date a decision not for active treatment had been made as recorded in clinic letters and/or clinical notes (including inpatient notes).
Surgical referral:	Whether or not there was evidence that the patient had been referred to a surgical department (either general surgery or a lower GI specific surgical team).
Surgical FSA:	Surgical clinic letters and notes and outpatient appointments were reviewed to ascertain if the patient was seen by a surgical department (as above) as part of the management of their initial disease (again excluding post progression).
Surgical FSA date:	If the patient was assessed by surgery the date of their first assessment by a clinician within this department was collected (including ward review post-op).
Primary resected:	Whether or not there was evidence that the primary tumour had been removed at any stage in management of the patient's disease. This included excision via endoscopy e.g. polypectomy. This was cross referenced against whether or not an anatomical pathology report existed for the primary

	tumour.
Other cancer-related surgical procedure:	Whether or not there was evidence that any other cancer-related surgical procedure not to remove primary or secondary (e.g. ileostomy formation prior to neo-adjuvant treatment) at any stage in management of the patient's disease was collected.
Surgical procedure:	All surgical procedures with the intent of removing primary disease, secondary disease or other related procedure (e.g. ileostomy formation) undertaken as part of the management of the patient's CRC. These were grouped by operation (i.e. multiple procedures could be collected per operation). These were collected separately for procedures for initial disease and then for any procedures post progression or recurrence. The name of each surgical procedure performed as recorded on the operation note was collected (if available; if not, clinical notes from the admission period or the name of the procedure on the discharge summary was used). For the purposes of this study, endoscopic removal, if it was not followed by a wider resection, was collected as part of this variable, to ensure removal of primary was adequately captured for the very early stage patient group.
Date of surgery:	The date of each operation as recorded on the operation note (if available, or clinical notes and/or discharge summary if not).
Date of discharge:	The date of discharge post each operation was collected from the discharge summary (if available, if not as recorded in inpatient medical records). If the patient was transferred from one hospital to another, the date of discharge from the subsequent hospital was collected.
Return to theatre:	Whether or not the patient required re-operation during the period between the first operation of the admission and the date of discharge for the admission was collected.
Anastomotic leak:	Whether or not an anastomotic leak occurring post first operation was documented on the discharge summary for each operative admission was collected.
Myocardial Infarction (MI):	Whether or not a MI occurring post first operation was documented on the discharge summary for each operative admission was collected.
Pulmonary Embolism (PE):	Whether or not a PE occurring post first operation was documented on the discharge summary for each operative admission was collected.
Completeness of excision:	Was assessed at 2 levels. First the operation note and post-op surgical clinic letters were reviewed for evidence of macroscopic residual disease at the time of surgery (R2 disease, categorised as incomplete excision).Then the anatomical pathology report was reviewed for reporting of R status or excision status of margins (proximal and distal for colon cases, proximal, distance and radial or circumferential for rectal cases). A R1 status or positive resection margin as per anatomical pathology report was also categorised as incomplete excision.
Multidisciplinary review:	Evidence of review at a colorectal multidisciplinary meeting (MDM) (requires at a minimum gastroenterology, surgery, pathology, radiology, medical oncology (MO) and radiation oncology (RO) representation) at any stage in the management of the patients CRC. The date of the first MDM was taken.
MO referral:	Whether or not there was evidence that the patient had been referred to a

	MO department.
MO FSA:	MO clinic letters and notes and outpatient appointments were reviewed to ascertain if the patient was seen by MO as part of the management of their initial disease (excluding post progression).
MO FSA date:	If the patient was assessed by MO the date of their first assessment by a clinician within this department was collected (including ward review post-op).
Offered chemotherapy:	MO clinic letters and notes were reviewed to ascertain if treatment with chemotherapy was offered for any aspect (i.e. neo-adjuvant and/ or adjuvant) of treatment of the patient's initial disease (chemotherapy post progressive disease was excluded).
Chemotherapy regimen:	Details of all individual chemotherapeutic agents were collected for each patient as recorded on the cytotoxic prescription sheets and corresponding MO clinic letters.
Chemotherapy start and stop dates:	Collected for each chemotherapeutic regimen. If an agent was stopped due to toxicity and the remaining agents continued (e.g. FOLFOX regimen stopping oxaliplatin and continuing with 5-fluorouracil (5FU) and leucovorin only) this was counted as two separate regimens. Start date was defined as day one cycle one and stop date as the day the last dose of chemotherapy was received by the patient (or assumed to be received in the case of oral capecitabine) as per the cytotoxic prescription sheets and corresponding MO clinic letters.
Reason for stopping chemotherapy:	Collected as interpreted from MO clinic letters. Options included: toxicity, progression or cancer or recurrence, planned duration completed, patient request, death, unrelated adverse event/ co-morbidity and unknown.
RO referral:	Whether or not there was evidence that the patient had been referred to a RO department.
RO FSA:	RO clinic letters and notes and outpatient appointments were reviewed to ascertain if the patient was seen by RO as part of the management of their initial disease (excluding post progression).
RO FSA date:	If the patient was assessed by RO the date of their first assessment by a clinician within this department was collected (including ward review post-op).
Offered radiotherapy:	RO clinic letters and notes were reviewed to ascertain if treatment with radiotherapy was offered for any aspect (i.e. neo-adjuvant and/or adjuvant) of treatment of the patient's initial disease. (Offer of radiotherapy post progressive disease as excluded.)
Radiotherapy treatment regimen:	Details of all radiotherapy treatment regimens received by the patient were collected for each patient as recorded on the radiotherapy treatment sheets and corresponding RO clinic letters. Options included: curative neo-adjuvant radiation, curative adjuvant radiation, and palliative radiation.
Radiotherapy start and stop dates:	Collected for each radiotherapy treatment regimen received by the patient as per the radiotherapy treatment sheets and corresponding RO clinic letters.
Completeness of	Whether or not the planned course of radiation therapy was received in full

radiotherapy treatment:	for each regimen.
Incomplete radiotherapy due to toxicity:	If the radiation therapy course was not received in full whether or not the reason for this was toxicity (collected for each radiotherapy treatment regimen received by the patient).

Calculated fields used in the report

Categorised surgical operations:
Surgical procedures were categorised into similar operations based on frequency of the expected operation. The categorised operations were then used to determine whether an operation was for:

- Removal of primary
- Removal of secondary
- Stoma
- Stent
- Other

Main surgery for removal of Primary:
A surgery for the removal of the primary was determined by whether during the admission period the patients had an operation that was coded as an operation for the removal of the primary. If a patient had more than one surgery admission with an operation for the removal of the primary the surgery considered to be the main surgery determined on review by one of the PIPER collaborating surgeons.
Endoscopic procedures:
All surgeries for the removal of primary were categorised as endoscopic or not. Endoscopic operations were only included as an operation for the removal of the primary if there was no other operation classified as an operation for the removal of the primary.
Completeness of excision:
This was determined from the post-op surgical clinic letters and the R status or excision status of margins from the pathology report.

- R2 (Macroscopic disease): R2 status on operations note or pathology
- R1 (Microscopic disease): R0 from operations note and R1 pathology
- R0 (Complete Excision): R0 from operations note and R1 pathology
- RX (Undeterminable): R) from operations note and RX pathology

Distance of tumour to circumferential resection margin recorded:
This was classified based on whether the distance of tumour to circumferential resection margin was recorded in the pathology notes.
Length of stay:
This was calculated for the main surgery for the removal of the primary and was calculated from the **date of surgery** and the **date of discharge.**
Mortality 30 days and 90:
This was calculated from the **date of surgery** and the date of death from the Ministry of Health mortality records.

MDM review:
This was calculated on timing of (first) MDM review in relation to patient's first treatment. MDM review more than 26 weeks prior to first treatment or 12 weeks post first treatment were classified as MDM reviewed. For those who were not treated the date of decision not to treat was used.

First treatment:
This was determined from the first event from the surgery for the removal of primary, removal of secondary, chemotherapy or radiotherapy.

Chemotherapy regimen:
The first course of chemotherapy is reported (i.e. the regimen they started on). We have reported only chemotherapeutic agents, not leucovorin, and not targeted agents (though very few patients received the latter).

Stopped chemotherapy early:
This is reported for the first course of chemotherapy only. Patients on combination therapy may have continued on one of the agents or patients may have changed to a different agent.

Reason for stopping chemotherapy:
The reason for stopping chemotherapy at the time above.

Duration of chemotherapy:
For this measure we have taken the total duration of chemotherapy across the whole first treatment period (before disease progression). The stop date recorded on the database was the date at which the last dose of chemotherapy was given.

3.2.5 Ministry of Health data

3.2.5.1 National Minimum dataset (hospital events)

The Ministry of Health provided, for each PIPER patient, information on all hospitalisations from 5 years before their diagnosis with CRC.

3.2.5.2 Mortality collection

The Ministry of Health provided mortality records for all PIPER patients who had died by 30th September 2013 date.

3.2.5.3 Co-morbidity score calculation

The level of comorbidity was assessed using the C3 Index develop by Sarfati et al which uses the information on the hospital discharge summary as recorded in the National Minimum Dataset. The index includes conditions identified by Sarfati et al as important chronic co-morbid conditions likely to impact on function or length of life. We included all these conditions listed on discharge summaries from within 5 years before diagnosis. In addition, following Sarfati et al, we included the same selected conditions where they were listed on the discharge summary for the admission in which the CRC was diagnosed apart from a small number of conditions which could have been adverse treatment effects or disease progression.

3.2.6 Statistics NZ data

Statistics NZ meshblocks provided urban/rural status and deprivation index and meshblock were used to calculate distance from health facility of diagnosis using the meshblock centroids.

3.2.6.1 *Meshblocks of patient addresses and health facilities*

Each patient was assigned a Statistics NZ 2006 meshblock based on their address at the time of diagnosis. According to Statistics NZ "a meshblock is the smallest geographic unit for which Statistics NZ collects statistical data. Meshblocks vary in size, from part of a city block to large areas of rural land. Each meshblock borders on another to cover all of NZ, extending out to the 200-mile economic zone (approximately 320 kilometres). Meshblocks are aggregated to build larger geographic areas, such as area units, territorial authorities, and regional councils. At the time of the 2013 Census, there were 46,637 meshblocks in NZ".

Similarly the health facility where the patient's diagnosis was made was assigned a meshblock. The meshblocks were used to assign urban/rural status based and deprivation index for each patient. Meshblocks for 2006 were used as it was felt they best represent the PIPER cohort.

Assigning of meshblocks to patients address was done using QAS Batch by Experian. This is an address correction and management system used primarily for formatting addresses to NZ Post standards or geocoding addresses. Each address was assigned initially a Statistics NZ 2011 meshblock. The 2011 meshblocks were mapped to 2006 meshblocks. Centroid coordinates were assigned to the 2006 meshblocks.

3.2.6.2 *Urban/ rural status*

The 2006 meshblocks were used to allocate urban/rural categorisation using the Statistics NZ urban/rural profile classification system.[6] This methodology classifies meshblocks into 3 urban and 4 rural categories based on their dependence upon a main urban area, which is assessed using the proxy of residential address compared to employment address (as per the 2006 census) as this measure is based on distance to employment area. (Figure 3.2-1 Urban-rural classification)

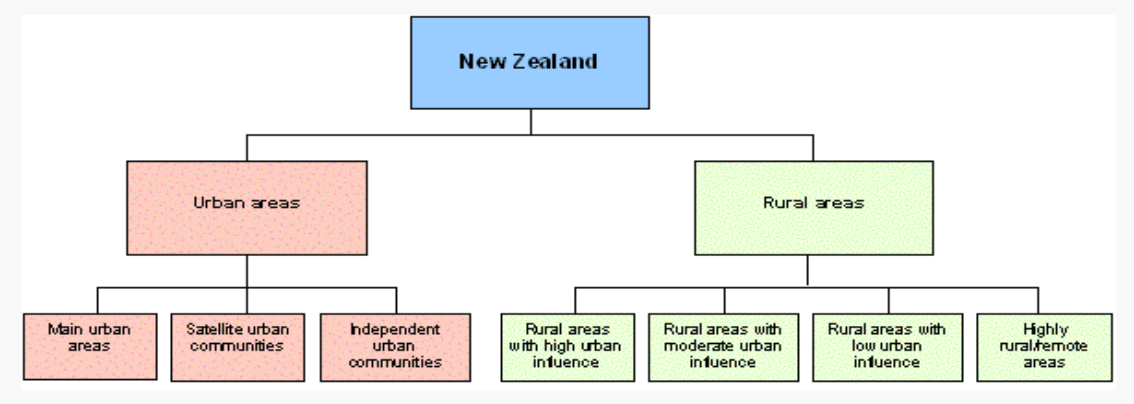

Figure 3.2-1 Urban-rural classification.

3.2.6.3 *Distance to health facility of diagnosis*

The centroids coordinates for the patient's meshblock from their address at diagnosis and the meshblock for the patient's health facility at diagnosis were used to calculate the distance to diagnostic facility. The Euclidean distance was calculated using the centroid coordinates. We have grouped the

distance measures for this report to ensure reasonable numbers in all categories for presentation of proportions. Future model fitting will allow more flexible use of the measure.

3.2.6.4 NZDep2006

The 2006 meshblocks for the patients address at diagnosis were used to allocate theNZDep2006 Index of Deprivation for each patient. The index provides a deprivation score to an area based on nine variables calculated from census data. The NZDep scores are cut into deciles (1=lowest deprivation to 10-highest deprivation), and for the most part we have grouped the deciles into quintiles for analyses in this report.

3.2.7 The PIPER Project database

A central Microsoft Access database was designed developed and maintained by CTNZ, the University of Auckland, for the collection of all data extracted from the medical records. The database is housed on the University of Auckland secure server and was only accessible by secure log-on and password. External sites accessed the database via remote session to the host server, which require individual user log on and password. The case list was imported into the database from the NZCR data set. Viewing and editing of cases by users was restricted to cases located in their region.

Data sourced from national databases were also stored in a Microsoft Access database housed on the University of Auckland secure server and only accessible by secure log-on and password.

3.2.8 Quality control

The database was developed using the fundamentals of good database design. The database was developed with branch logic, limited field entry and dropdown lists to attain quality data entry. Reports were produced to ascertain completeness of data collection for individual patients.

The following steps were taken to maintain consistent data extraction across the various centres: each of the Data Managers was inducted to the Project by the Project Manager; a Data Collection Manual was developed and distributed to all Data Managers that contained a definition for each data field and suggested documents to obtain the data from listed in priority of or relevance if more than one source was identified; two visits to each site to conduct duplicate data extraction; review and feedback with the Data Manager were undertaken by the Project Manager; queries from Data Managers were forwarded to the Project Manager for review and resolution (including clinical review by the project Principal Investigator, Clinical Lead and or other Co-Investigator) and documented in a separate query database - resolved queries were then disseminated to the Data Managers via email and also discussed at monthly teleconferences.

3.2.9 Data cleaning

The data extracted from the medical records was checked for consistency. Where the database branch logic was not sufficient further checks were carried out with particular focus around staging, initial diagnosis, initial treatment and surgery for removal of primary. Date fields were checked for consistency against other relevant dates. Queries generated by these checks were forwarded to the regional Data Managers or to the Project Manager for resolution. Due to the nature of the data collection process not all data points were checked for all the queries generated.

Where it was not possible to assign data to a predefined category for a particular field open text was permitted in the database. To assign these entries a relevant category for dissemination of the results data entered into the open text field was sent to a PIPER advisor, whose field of expertise covered the data field in question, for categorising.

3.3 Statistical Considerations

3.3.1 Statistical Analysis

Frequency tables, boxplots and violin plots and standard summary statistics are used to describe the data.

This first report is mainly descriptive, so minimal statistical analyses are presented. Overall proportions are presented with 95% confidence intervals calculated according to the exact (Clopper-Pearson) method. The p-values comparing associations in tables are Chi-squared tests unless one or more of the expected cell numbers is very small, in which case Fisher's exact test was used. Unknowns were excluded when calculating p-values.

We have not made adjustments for multiple testing because of the descriptive nature of the report. The p-values are intended as a guide to give some indication of the influence of random variation. The statistical analyses are not intended to be definitive as comparisons in this report do not consider the influence of any confounding factors such as demographic and clinical characteristics of patients or the interplay between rurality, distance, ethnicity and deprivation.

3.3.2 Sample Size Justification

In the calendar years of 2007 and 2008 we expect to identify approximately 5,600 patients with CRC (Table 3.3-1). Of these roughly 14% will be Māori and 14% rural[1,2], and 68% will have colon cancer[16].

Table 3.3-1 Cancer Registrations: site by ethnicity (2007 and 2008)[1]

Year	Site		Ethnicity Māori	Pacific	Other	Not stated	Total
2007	C18	Colon	70	14	1702	56	1842
	C19	Rectosigmoid junction	7	1	147	4	159
	C20	Rectum	50	15	669	21	755
2008	C18	Colon	74	27	1739	42	1882
	C19	Rectosigmoid junction	7	2	195	6	210
	C20	Rectum	38	16	587	21	662
Total			246	75	5039	150	5510

Comparisons of KPIs are stage specific; the stage distributions and numbers are given in Table 3.3-2 and Table 3.3-3. To detect a difference between proportions of 0.8 and 0.9 with 80% power at the 2-sided 0.05 level, the required sample size is 819. So the study will have high power for stage II and III colon

cancer KPI comparisons. For stage I and IV colon cancer and all stages of rectal cancer the study will have at least 80% power to detect differences in proportions at least as small as 0.19 - 0.2.

Table 3.3-2 Expected number of cases of colon cancers by stage

Stage	N	%
Stage I	419	11
Stage II	1752	46
Stage III	952	25
Stage IV	685	18
Total	3808	100

Table 3.3-3 Expected number of cases of rectal cancers by stage

Stage	N	%
Localised	878	49
Regional invasion	512	29
Metastatic	401	22
Total	1792	100

For comparisons by ethnicity we will use data from the years 2006 – 2011, with approximately 738 Māori, 225 Pacific cases and a randomly sampled group of 738 nMnP. For KPIs which are relevant to the whole group (such as acute versus non acute presentation) where the prevalence of the KPI is between 20% and 80%, the additional data will give at least 80% power to detect differences in true proportions of 8% or more for Māori versus Non-Māori /Non Pacific and 11% for Pacific versus Non-Māori /Non-Pacific. However most of the KPIs for health care decisions or health care quality are stage-specific, so the power will be much lower. We expect about 25% of patients to be diagnosed with stage IV colorectal disease and 30% with each of stage II and III colorectal disease.[3] The 25% gives approximately 180 stage IV patients in the Māori and non-Māori groups; the differences in prevalence between Māori and Non Māori would need to be 15% or more to give 80% power with this number. The power will be lower for comparisons with the Pacific patient group and for any comparisons that do not involve the whole study cohort.

3.4 Project Approval and Conduct

3.4.1 Ethical considerations

3.4.1.1 Ethics committee approval& informed consent

Approval for the project was granted by the Multi-Region Ethics Committee (*reference number MEC/12/EXP/022).* Approval was granted for data to be collected without individual patient consent.

3.4.2 Project Management

The project was overseen by an Advisory Group, formed specifically for the purpose of advising this project. Members have been selected to compliment the geographical and disciplinary areas of the

investigators, to allow representation from the majority of the regional cancer centres and disciplines involved in the management of CRC cases, along with multi-ethnic and consumer representation. The advisory group met with the Co-Investigators twice a year, and oversaw all aspects of the project from design/ development, through implementation, analysis, interpretation and dissemination.

4 Results

4.1 Description of the PIPER study cohort

There were 5612 registrations of CRC on the NZCR during the years 2007 and 2008. In the extended cohort there were an additional 244 Māori patients, 99 Pacific and 432 nMnP patients. This gave 6387 potentially eligible cases for review.

Of these 6387 patients, 5667 (89%) were determined to be eligible for the PIPER study. The proportions that were eligible were found to be similar across calendar years (Table 4.1-1). For 151 patients (2%) no evidence of CRC was found in their clinical note review. Amongst the remaining exclusions the main reasons for ineligibility were tumours other than adenocarcinoma (3%) and a non-colorectal primary (2%).

Table 4.1-2 and Table 4.1-3 show eligibility by health facility region and ethnicity respectively. A lower proportion of Pacific patients diagnosed with CRC were eligible. Numbers are small, but this seems to reflect higher proportions with colorectal tumours other than adenocarcinoma, and a greater proportion where the patient is not a resident in NZ.

Table 4.1-1 CRC cases reported to the NZ Cancer Registry as diagnosed in the years 2006-2009 according to eligibility for the PIPER study. All cases diagnosed in the years 2007 and 2008 are included, as are all Māori and all Pacific patients, and a stratified random sample of nMnP patients diagnosed in 2006 and 2009

Eligibility	Diagnosis year									
	2006		2007		2008		2009			
	N	%	N	%	N	%	N	%	Total	%
Eligible	316	86.6	2486	88.5	2501	89.3	364	88.8	5667	88.7
Ineligible - non adenocarcinoma	16	4.4	69	2.5	67	2.4	20	4.9	172	2.7
Ineligible - non colorectal primary	10	2.7	46	1.6	57	2.0	7	1.7	120	1.9
Ineligible – diagnosed outside NZ	6	1.6	26	0.9	19	0.7	7	1.7	58	0.9
Ineligible - outside of study timeframe	2	0.5	52	1.9	40	1.4	1	0.2	95	1.5
Ineligible - patient not NZ resident	0	0	5	0.2	3	0.1	2	0.5	10	0.2
Ineligible - recurrent disease	2	0.5	23	0.8	22	0.8	0	0	47	0.7
No evidence of cancer in medical record	9	2.5	71	2.5	63	2.2	8	2.0	151	2.4
No information available on the patient	4	1.1	32	1.1	30	1.1	1	0.2	67	1.0
Total	365	100.0	2810	100.0	2802	100.0	410	100.0	6387	100.0

Table 4.1-2 Eligibility for PIPER by health facility region

Eligibility	Health Facility Region													
	Auckland		Waikato		Palmerston North		Capital & Coast		Canterbury		Southern			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Eligible	1755	87.9	912	85.1	865	93.0	511	84.6	1090	90.2	534	92.5	5667	88.7
Ineligible - non adenocarcinoma	61	3.1	52	4.9	21	2.3	16	2.6	14	1.2	8	1.4	172	2.7
Ineligible - non colorectal primary	31	1.6	20	1.9	21	2.3	16	2.6	26	2.2	6	1.0	120	1.9
Ineligible - outside NZ	31	1.6	5	0.5	5	0.5	13	2.2	4	0.3	0	0	58	0.9
Ineligible - outside of study timeframe	32	1.6	20	1.9	4	0.4	11	1.8	20	1.7	8	1.4	95	1.5
Ineligible - patient not NZ resident	6	0.3	1	0.1	1	0.1	0	0	0	0	2	0.3	10	0.2
Ineligible - recurrent disease	12	0.6	12	1.1	0	0	7	1.2	10	0.8	6	1.0	47	0.7
No evidence of cancer in medical record	39	2.0	29	2.7	7	0.8	26	4.3	39	3.2	11	1.9	151	2.4
No information available on the patient	29	1.5	21	2.0	6	0.6	4	0.7	5	0.4	2	0.3	67	1.0
Total	1996	100.0	1072	100.0	930	100.0	604	100.0	1208	100.0	577	100.0	6387	100.0

Health Facilities:
Auckland = Auckland, Counties Manukau, Northland and Waitemata District Health Boards (DHBs)
Waikato = Bay of Plenty, Lakes and Waikato DHBs
Palmerston North = Hawkes Bay, MidCentral, Tairawhiti, Taranaki and Whanganui DHBs
Capital and Coast = Capital and Coast, Hutt Valley and Wairarapa DHBs
Canterbury = Canterbury, Nelson Marlborough, South Canterbury and West Coast DHBs
Southern = Southern DHB

Table 4.1-3 Eligibility for PIPER by ethnicity (prioritised* ethnicity as recorded on the Cancer Registry)

Eligibility	NZCR Prioritised Ethnicity L2									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Eligible	463	85.1	142	80.2	4952	89.6	110	79.7	5667	88.7
Ineligible - non adenocarcinoma	32	5.9	12	6.8	121	2.2	7	5.1	172	2.7
Ineligible - non colorectal primary	15	2.8	8	4.5	94	1.7	3	2.2	120	1.9
Ineligible - outside NZ	10	1.8	7	4.0	39	0.7	2	1.4	58	0.9
Ineligible - outside of study timeframe	6	1.1	1	0.6	86	1.6	2	1.4	95	1.5
Ineligible - patient not NZ resident	0	0	2	1.1	7	0.1	1	0.7	10	0.2
Ineligible - recurrent disease	0	0	0	0	47	0.9	0	0	47	0.7
No evidence of cancer in medical record	16	2.9	4	2.3	127	2.3	4	2.9	151	2.4
No information available on the patient	2	0.4	1	0.6	55	1.0	9	6.5	67	1.0
Total	544	100.0	177	100.0	5528	100.0	138	100.0	6387	100.0

*Each individual is allocated to a single ethnic group on the basis of the following priority: Māori, Pacific, and nMnP

4.1.1 Key Points: PIPER study cohort

The PIPER Cohort was drawn from all new occurrences of colon and rectal adenocarcinoma recorded on the NZCR as having been diagnosed between 1 January 2007 and 31 December 2008, as well as an additional cohort of Māori and Pacific patients.

6387 records were identified from the NZCR as being potentially eligible, of which 5667 (89%) met our eligibility criteria.

4.1.2 Discussion: PIPER study cohort

The NZCR is the central repository for all new cancer diagnoses, and the Cancer Registry Act 1993 mandates that all new diagnoses are registered. In addition to collecting date of diagnosis, tumour morphology, and basic demographic data, the NZCR also collects some staging information. The NZCR is reliant on submitted data.

We observed a high level of accuracy of with respect to the CRC diagnosis on the NZCR; only 2% of those coded as ICD-10 C18-20 were found to have a non-colorectal primary on hand search of the medical record, and a further 2.4% had no evidence of cancer in the medical record. Other reasons for ineligibility included non-adenocarcinoma primary, which would still correctly be coded as C18-20 in the Registry but is outside the scope of the current project.

Further work is planned to compare the data held by the NZCR against that found in the current study.

4.2 Demographic characteristics of the patients in the PIPER cohort

4.2.1 Demographic characteristics

Of the 5667 patients included in the PIPER study, 4193 (74%) were diagnosed with colon cancer, 1401 (25%) with rectal cancer and for the remaining 73 (1%) the site of the primary CRC was unknown.

The Auckland health facility region had the highest proportion of patients nationally (31%), reflecting the relative size of the population catchment(Table 4.2-1).Of the 73 patients where site of the primary tumour was unknown, 66% resided in the Auckland health facility region. This region has the largest number of private physicians and practices across which patients could be seen. Assiduous attempts were made to obtain data from private practices, but some clinicians did not respond or declined access, and some others had retired and were not able to be contacted. Hence data collection in Auckland was particularly challenging and there was more missing data across study fields from this region.

Table 4.2-1 Site of primary tumour (rectum vs. colon) by health facility

Health Facility at diagnosis	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
Auckland	1270	30.3	437	31.2	48	65.8	1755	31.0
Waikato	703	16.8	202	14.4	7	9.6	912	16.1
Palmerston North	629	15.0	220	15.7	16	21.9	865	15.3
Capital & Coast	390	9.3	119	8.5	2	2.7	511	9.0
Canterbury	813	19.4	277	19.8	0	0	1090	19.2
Southern	388	9.3	146	10.4	0	0	534	9.4
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

The age distribution for patients diagnosed with rectal cancer was lower than for patients diagnosed with colon cancer (Table 4.2-2), with mean age (SD) of 67.9 (12.4) and 71.4 (12.2) years respectively. The proportion of females was higher for colon cancer than rectal cancer (51% female with colon cancer, 38% female with rectal cancer) (Table 4.2-3).

The ethnicity classification used for the PIPER study was based on the level 2 prioritised ethnicity as recorded on the NZCR, which was compared to and then updated if required from the medical records. Within the medical record self-reported ethnicity was selected, where it existed. Comparison to the medical records yielded an additional 4 patients who were found to be Māori and an additional 6 who were found to be Pacific.

Overall 8% of the PIPER patients were recorded as Māori, 3% as Pacific, and 2% as Asian (Table 4.2-4). The proportions with rectal cancer (compared with colon cancer) were higher in Māori and Pacific patients (30% and 41% respectively) than in European (24%) or Asian

(26%) patients. For the remainder of the report ethnicity is classified in three groups: Māori, Pacific and nMnP.

Table 4.2-2 Age at diagnosis by site of primary tumour (rectum vs. colon)

Age group at diagnosis	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
<40	79	1.9	30	2.1	0	0	109	1.9
40-49	169	4.0	91	6.5	0	0	260	4.6
50-59	437	10.4	228	16.3	13	17.8	678	12.0
60-69	1014	24.2	401	28.6	17	23.3	1432	25.3
70-79	1405	33.5	406	29.0	15	20.5	1826	32.2
>=80	1078	25.7	242	17.3	20	27.4	1340	23.6
Unknown	11	0.3	3	0.2	8	11.0	22	0.4
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

Table 4.2-3 Gender by site of primary tumour (rectum vs. colon)

Gender	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
Female	2155	51.4	525	37.5	35	47.9	2715	47.9
Male	2038	48.6	876	62.5	38	52.1	2952	52.1
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

Table 4.2-4 Prioritised ethnicity by site of primary tumour (rectum vs. colon)

Prioritised ethnicity	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
Māori	310	7.4	136	9.7	13	17.8	459	8.1
Pacific	86	2.1	59	4.2	3	4.1	148	2.6
Asian	95	2.3	33	2.4	2	2.7	130	2.3
Other	17	0.4	8	0.6	0	0	25	0.4
European	3667	87.5	1161	82.9	49	67.1	4877	86.1
Unknown	18	0.4	4	0.3	6	8.2	28	0.5
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

Based on the meshblock of diagnosis, PIPER patients were classified according to rurality, distance from the health facility where they were diagnosed and NZ Deprivation Index area score (Table 4.2-5, Table 4.2-6, Table 4.2-7, Table 4.2-8). There were no clear differences in cancer site by deprivation score, rurality of place of residence at diagnosis or distance from the health facility where their CRC was diagnosed.

For the remainder of the report we have presented data according to quintile of the NZ Deprivation Index, and in three categories of rurality: urban, independent urban and rural (see methods section for further description of these categories).

Table 4.2-5 Urban/rural classification of the meshblock of residence at diagnosis by site of primary tumour (rectum vs. colon)

Rurality at diagnosis	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
Main urban area	2754	65.7	902	64.4	18	24.7	3674	64.8
Satellite Urban Area	158	3.8	61	4.4	2	2.7	221	3.9
Independent Urban Area	724	17.3	221	15.8	5	6.8	950	16.8
Rural area with high urban influence	98	2.3	39	2.8	1	1.4	138	2.4
Rural area with moderate urban influence	115	2.7	52	3.7	1	1.4	168	3.0
Rural area with low urban influence	191	4.6	66	4.7	2	2.7	259	4.6
Highly rural/remote area	49	1.2	22	1.6	1	1.4	72	1.3
Unknown	104	2.5	38	2.7	43	58.9	185	3.3
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

Table 4.2-6 Urban/rural classification of the meshblock of residence at diagnosis by site of primary tumour (rectum vs. colon)

Rurality at diagnosis (grouped)	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
Urban	2912	69.4	963	68.7	20	27.4	3895	68.7
Independent urban	724	17.3	221	15.8	5	6.8	950	16.8
Rural	453	10.8	179	12.8	5	6.8	637	11.2
Unknown	104	2.5	38	2.7	43	58.9	185	3.3
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

Table 4.2-7 Distance from centroid of meshblock of residence at diagnosis to the health facility of diagnosis by site of primary tumour (rectum vs. colon)

Distance lived from facility of diagnosis (grouped)	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
0-<5	1449	34.6	473	33.8	11	15.1	1933	34.1
5-<10	852	20.3	275	19.6	3	4.1	1130	19.9
10-<20	650	15.5	209	14.9	6	8.2	865	15.3
20-<50	682	16.3	244	17.4	5	6.8	931	16.4
50-<100	448	10.7	156	11.1	5	6.8	609	10.7
Unknown	112	2.7	44	3.1	43	58.9	199	3.5
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

Table 4.2-8 NZ Deprivation Index (decile) for residence at diagnosis by site of primary tumour (rectum vs. colon)

NZ Deprivation Index* at diagnosis	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
1	403	9.6	136	9.7	3	4.1	542	9.6
2	395	9.4	129	9.2	2	2.7	526	9.3
3	408	9.7	132	9.4	4	5.5	544	9.6
4	392	9.3	139	9.9	4	5.5	535	9.4
5	444	10.6	150	10.7	3	4.1	597	10.5
6	470	11.2	130	9.3	3	4.1	603	10.6
7	432	10.3	155	11.1	1	1.4	588	10.4
8	411	9.8	127	9.1	3	4.1	541	9.5
9	396	9.4	126	9.0	2	2.7	524	9.2
10	315	7.5	132	9.4	5	6.8	452	8.0
Unknown	127	3.0	45	3.2	43	58.9	215	3.8
Total	4193	100.0	1401	100.0	73	100.0	5667	100.0

*The NZ Deprivation Index is an area measure of deprivation. Higher values index indicate greater deprivation.

4.2.2 Associations between demographic characteristics

The distribution of age at diagnosis differed by ethnicity, with Māori patients tending to be younger than nMnP patients at diagnosis. The Pacific patient group had a larger proportion under 60 at diagnosis than either Māori or nMnP (Figure 4.2-1, Table 4.2-9). (Note: in the figure the area of the shape shows the distribution of age in each group).

There does not appear to be a relationship between age and the NZ Deprivation Index score (Figure 4.2-2, Table 4.2-10), whereas the differences in age distribution by rurality are very marked (Figure 4.2-3, Table 4.2-11). The group of CRC patients living in rural areas is much younger than those in urban areas. This is likely to represent the difference in the overall age distribution of the urban and rural populations. There were differences in age distribution by distance of the patient's residence from the facility where their cancer was diagnosed, but the patients who over 50 km from the health facility do tend to be younger.

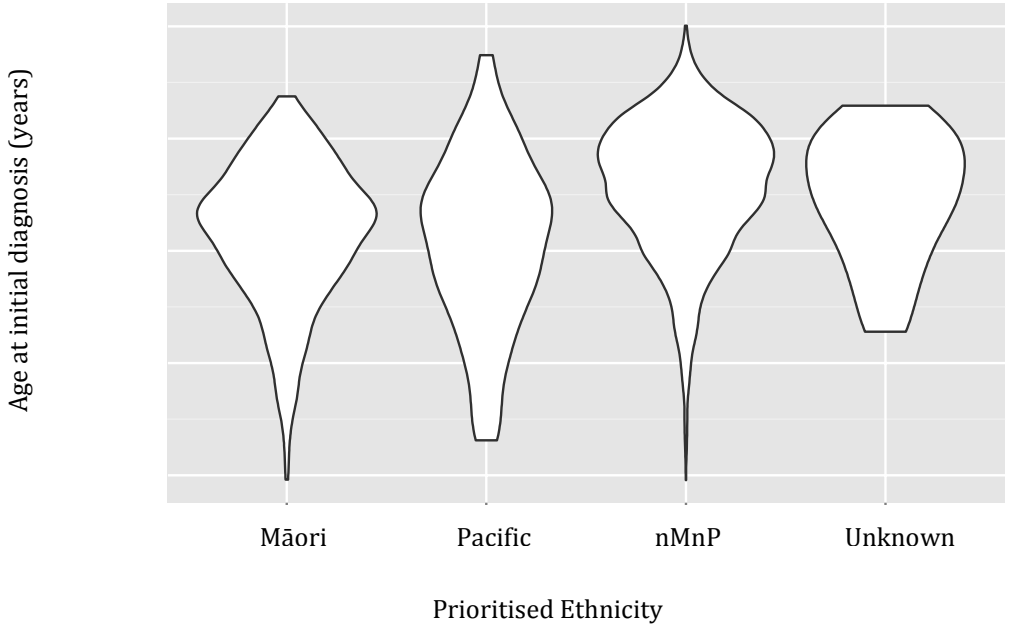

Figure 4.2-1 Age (in years) at diagnosis by prioritised ethnicity.

Table 4.2-9 Age (in years) at diagnosis by prioritised ethnicity

Age at diagnosis	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	23	5.0	15	10.1	71	1.4	0	0	109	1.9
40-49	41	8.9	16	10.8	201	4.0	2	7.1	260	4.6
50-59	96	20.9	31	20.9	547	10.9	4	14.3	678	12.0
60-69	164	35.7	44	29.7	1217	24.2	7	25.0	1432	25.3
70-79	98	21.4	25	16.9	1695	33.7	8	28.6	1826	32.2
>=80	34	7.4	16	10.8	1283	25.5	7	25.0	1340	23.6
Unknown	3	0.7	1	0.7	18	0.4	0	0	22	0.4
Total	459	100.0	148	100.0	5032	100.0	28	100.0	5667	100.0

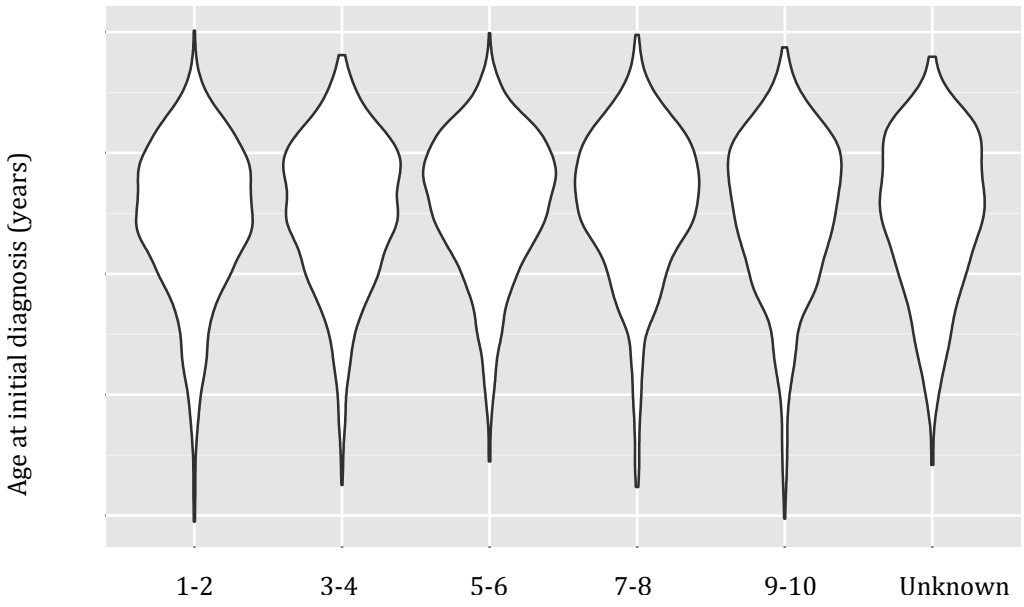

Figure 4.2-2 Age (in years) at diagnosis by NZ Deprivation Index (quintile) of residence at diagnosis.

Table 4.2-10 Age (in years) at diagnosis by NZ Deprivation Index of residence at diagnosis

Age at diagnosis	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	25	2.3	20	1.9	12	1.0	25	2.2	24	2.5	3	1.4	109	1.9
40-49	66	6.2	49	4.5	49	4.1	33	2.9	50	5.1	13	6.0	260	4.6
50-59	134	12.5	141	13.1	118	9.8	126	11.2	131	13.4	28	13.0	678	12.0
60-69	297	27.8	286	26.5	291	24.3	273	24.2	233	23.9	52	24.2	1432	25.3
70-79	340	31.8	332	30.8	424	35.3	379	33.6	298	30.5	53	24.7	1826	32.2
>=80	204	19.1	250	23.2	304	25.3	290	25.7	240	24.6	52	24.2	1340	23.6
Unknown	2	0.2	1	0.1	2	0.2	3	0.3	0	0	14	6.5	22	0.4
Total	1068	100.0	1079	100.0	1200	100.0	1129	100.0	976	100.0	215	100.0	5667	100.0

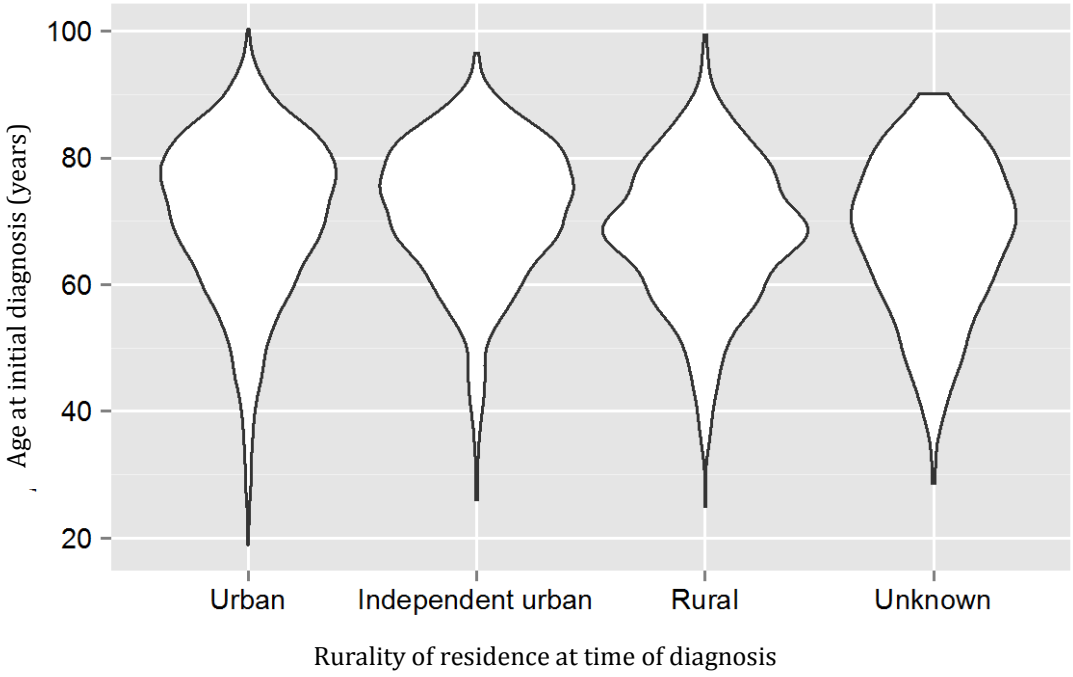

Figure 4.2-3 Age (in years) by rurality of residence at diagnosis.

Table 4.2-11 Age (in years) at diagnosis by rurality of residence at diagnosis

	Rurality of residence at time of diagnosis									
Age at diagnosis	**Urban**		**Independent urban**		**Rural**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
<40	86	2.2	10	1.1	10	1.6	3	1.6	109	1.9
40-49	185	4.7	29	3.1	33	5.2	13	7.0	260	4.6
50-59	455	11.7	93	9.8	102	16.0	28	15.1	678	12.0
60-69	924	23.7	247	26.0	210	33.0	51	27.6	1432	25.3
70-79	1258	32.3	334	35.2	187	29.4	47	25.4	1826	32.2
>=80	983	25.2	235	24.7	93	14.6	29	15.7	1340	23.6
Unknown	4	0.1	2	0.2	2	0.3	14	7.6	22	0.4
Total	3895	100.0	950	100.0	637	100.0	185	100.0	5667	100.0

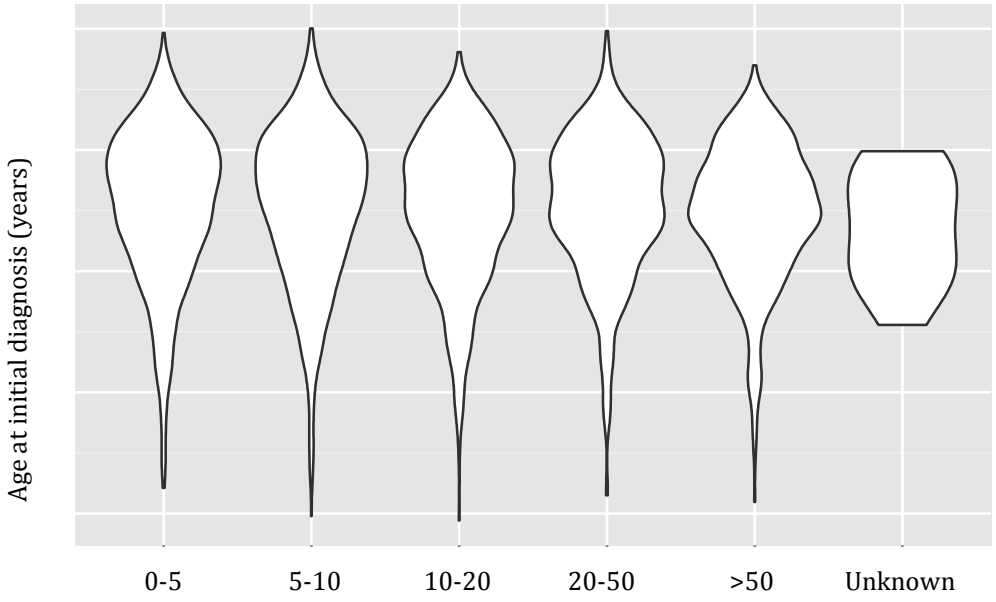

Figure 4.2-4 Age at diagnosis by distance of residence at diagnosis from the health facility of diagnosis.

Table 4.2-12 Age at diagnosis by distance of residence at diagnosis to health facility of diagnosis

Age at diagnosis	Distance from residence to facility of diagnosis (km)															
	0-<5		5-<10		10-<20		20-<50		50-<100		>100		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	41	2.1	23	2.0	17	2.0	15	1.6	6	1.4	4	2.4	3	1.5	109	1.9
40-49	92	4.8	54	4.8	46	5.3	31	3.3	16	3.6	8	4.7	13	6.5	260	4.6
50-59	210	10.9	143	12.7	109	12.6	111	11.9	50	11.4	23	13.6	32	16.1	678	12.0
60-69	460	23.8	249	22.0	225	26.0	250	26.9	136	30.9	58	34.3	54	27.1	1432	25.3
70-79	614	31.8	370	32.7	281	32.5	314	33.7	141	32.0	55	32.5	51	25.6	1826	32.2
>=80	513	26.5	291	25.8	186	21.5	208	22.3	91	20.7	21	12.4	30	15.1	1340	23.6
Unknown	3	0.2	0	0	1	0.1	2	0.2	0	0	0	0	16	8.0	22	0.4
Total	1933	100.0	1130	100.0	865	100.0	931	100.0	440	100.0	169	100.0	199	100.0	5667	100.0

Comparison of ethnicity to deprivation, rurality and distance of residence from health facility of diagnosis, showed strong relationships, which will need to be taken into account in order to understand patterns of care. A higher proportion of Māori patients and Pacific patients were living in deprived areas compared to nMnP patients (Table 4.2-13). The proportions in quintile 9-10 (the most deprived) were: Māori 41%; Pacific 45% and nMnP 14%.

The proportion of Pacific patients living urban areas was much higher than Māori and nMnP patients (91% compared with 61% and 69% respectively, Table 4.2-14). Consequently the distance from the health facility of diagnosis was shorter for Pacific patients than for Māori or nMnP (Table 4.2-15).

Table 4.2-13 NZ Deprivation Index of residence at diagnosis by prioritised ethnicity

Diagnosis Deprivation Index 2006	Prioritised Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
1-2	32	7.0	8	5.4	1024	20.3	4	14.3	1068	18.8
3-4	56	12.2	13	8.8	1005	20.0	5	17.9	1079	19.0
5-6	62	13.5	17	11.5	1116	22.2	5	17.9	1200	21.2
7-8	102	22.2	39	26.4	986	19.6	2	7.1	1129	19.9
9-10	189	41.2	66	44.6	720	14.3	1	3.6	976	17.2
Unknown	18	3.9	5	3.4	181	3.6	11	39.3	215	3.8
Total	459	100.0	148	100.0	5032	100.0	28	100.0	5667	100.0

Table 4.2-14 Rurality of residence at diagnosis by prioritised ethnicity

Diagnosis Rurality	Prioritised Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Urban	282	61.4	134	90.5	3464	68.8	15	53.6	3895	68.7
Independent urban	79	17.2	5	3.4	865	17.2	1	3.6	950	16.8
Rural	81	17.6	4	2.7	551	10.9	1	3.6	637	11.2
Unknown	17	3.7	5	3.4	152	3.0	11	39.3	185	3.3
Total	459	100.0	148	100.0	5032	100.0	28	100.0	5667	100.0

Table 4.2-15 Distance of residence at diagnosis from health facility of diagnosis by prioritised ethnicity

Diagnosis distance from health facility	Prioritised Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0-<5	135	29.4	68	45.9	1724	34.3	6	21.4	1933	34.1
5-<10	72	15.7	42	28.4	1013	20.1	3	10.7	1130	19.9
10-<20	64	13.9	22	14.9	775	15.4	4	14.3	865	15.3
20-<50	90	19.6	8	5.4	830	16.5	3	10.7	931	16.4
50-<100	59	12.9	2	1.4	378	7.5	1	3.6	440	7.8
>100	20	4.4	1	0.7	148	2.9	0	0	169	3.0
Unknown	19	4.1	5	3.4	164	3.3	11	39.3	199	3.5
Total	459	100.0	148	100.0	5032	100.0	28	100.0	5667	100.0

There was also a strong association between rurality and NZ Deprivation Index of residence at diagnosis. The areas with the greatest deprivation were independent urban areas. The proportions in the highest quintile (9-10) were: Independent urban 26%; urban 18% and rural 8% (Table 4.2-16). The proportions of patients living >50 km from the health facility at which they were diagnosed were similar in independent urban and rural areas (10% and 9% respectively), both higher than for urban areas (1%). The areas with the highest deprivation tended to be closer to the health facility of diagnosis. Among the areas in the lowest quintile of deprivation, 29% of patients lived within 5 km of the health facility at which they were diagnosed, compared with 43% in the highest deprivation quintile. As would be expected patients in rural areas tended to live further from the health facility where they were diagnosed.

Table 4.2-16 NZ Deprivation Index by rurality of residence at diagnosis

Diagnosis Deprivation Index 2006	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
1-2	816	20.9	88	9.3	164	25.7	0	0	1068	18.8
3-4	776	19.9	144	15.2	159	25.0	0	0	1079	19.0
5-6	841	21.6	186	19.6	173	27.2	0	0	1200	21.2
7-8	752	19.3	286	30.1	91	14.3	0	0	1129	19.9
9-10	685	17.6	242	25.5	49	7.7	0	0	976	17.2
Unknown	25	0.6	4	0.4	1	0.2	185	100.0	215	3.8
Total	3895	100.0	950	100.0	637	100.0	185	100.0	5667	100.0

Table 4.2-17 Distance from health facility of diagnosis by rurality of residence at diagnosis

Diagnosis distance from health facility	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0-<5	1676	43.0	255	26.8	2	0.3	0	0	1933	34.1
5-<10	1084	27.8	18	1.9	28	4.4	0	0	1130	19.9
10-<20	737	18.9	19	2.0	109	17.1	0	0	865	15.3
20-<50	312	8.0	328	34.5	291	45.7	0	0	931	16.4
50-<100	55	1.4	238	25.1	147	23.1	0	0	440	7.8
>100	22	0.6	90	9.5	57	8.9	0	0	169	3.0
Unknown	9	0.2	2	0.2	3	0.5	185	100.0	199	3.5
Total	3895	100.0	950	100.0	637	100.0	185	100.0	5667	100.0

Table 4.2-18 Distance from health facility of diagnosis by NZ Deprivation Index of residence at diagnosis

Diagnosis distance from health facility	Deprivation index 2006													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
0-<5	307	28.7	357	33.1	422	35.2	422	37.4	420	43.0	5	2.3	1933	34.1
5-<10	311	29.1	241	22.3	217	18.1	199	17.6	155	15.9	7	3.3	1130	19.9
10-<20	218	20.4	177	16.4	210	17.5	145	12.8	108	11.1	7	3.3	865	15.3
20-<50	143	13.4	199	18.4	193	16.1	215	19.0	171	17.5	10	4.7	931	16.4
50-<100	51	4.8	67	6.2	111	9.3	115	10.2	95	9.7	1	0.5	440	7.8
>100	32	3.0	35	3.2	46	3.8	31	2.7	25	2.6	0	0	169	3.0
Unknown	6	0.6	3	0.3	1	0.1	2	0.2	2	0.2	185	86.0	199	3.5
Total	1068	100.0	1079	100.0	1200	100.0	1129	100.0	976	100.0	215	100.0	5667	100.0

4.2.3 Comparison of demographic characteristics and stage of cancer

Stage of disease was recorded at 3 points in the patient journey: before surgery for resection of their tumour, after surgery (when the pathology report was available) and 8 weeks after surgery to allow a window for radiology for detection of metastatic disease to be carried out.

4.2.3.1 Colon cancer

Pre-operative stage was unknown for 8% of patients diagnosed with colon cancer (Table 4.2-19); the remainder could be classified as non-metastatic or metastatic (stage IV) at presentation, but as TNM stage is not available for most patients before surgery further categorisation was not possible. The proportion of patients who presented with metastatic disease was 23%.

After surgery, disease could be further classified for the majority of patients with colon as stage I, II or III; however for 228 (8%) of the stage I-III patients, the exact stage of their disease was still unknown after surgery, and they are classified as having non-metastatic NOS (not otherwise stated) disease. For 24 patients whose disease was initially classified as stage I-III, further investigations found evidence of metastatic disease and their disease was reclassified as stage IV. There were 8 patients for who the information on TNM stage was still incomplete after surgery, so the stage of their disease could not be classified post-operatively.

During the 8 week period after initial surgery 14 patients whose disease was classified as Stage I-III post-operatively were found to have metastatic disease (Table 4.2-20). The age distribution differed by stage of disease at diagnosis. For patients who were stage I-III the proportion who were 70 years or over was 61%, whereas for those with stage IV disease the proportion was 52% (Table 4.2-21). Males were more likely to be diagnosed with stage IV disease (53% for men compared with 47% for women) (Table 4.2-22). There was no difference in stage at diagnosis by rurality (Table 4.2-23) although this has not been adjusted by gender. Patients living 5-10km from the health facility of diagnosis were slightly more likely to be diagnosed with stage I-II disease (73% compared with 70% or less for other distance groups) (Table 4.2-24). There was no clear pattern in stage at diagnosis by deprivation (Table 4.2-25), although it is noted that Dep9-10 were least likely to be diagnosed with stage I disease. Both Māori patients and Pacific patients were more likely to be diagnosed with stage IV disease (30% and 34% respectively, compared with 22% for nMnP (Table 4.2-26).

Table 4.2-19 Staging of colon cancer patients: comparison of pre-operative and post-operative stage.

Pre-operative stage	Post-operative stage: I		II		III		Non-metastatic NOS		IV		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Non-metastatic	498	99.0	1133	99.5	1025	99.0	228	100.0	24	2.4	8	2.7	2916	69.5
Metastatic	0	0	0	0	0	0	0	0	956	96.5	0	0	956	22.8
Unknown	5	1.0	6	0.5	10	1.0	0	0	11	1.1	289	97.3	321	7.7
Total	503	100.0	1139	100.0	1035	100.0	228	100.0	991	100.0	297	100.0	4193	100.0

Table 4.2-20 Staging of colon cancer patients: comparison of post-operative stage and stage at 8 weeks after surgery

Post-operative stage	Stage at 8 weeks after resection of primary: I		II		III		Non-metastatic NOS		IV		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
I	502	100.0	0	0	0	0	0	0	1	0.1	0	0	503	12.0
II	0	0	1136	100.0	0	0	0	0	3	0.3	0	0	1139	27.2
III	0	0	0	0	1025	100.0	0	0	10	1.0	0	0	1035	24.7
Non-metastatic NOS	0	0	0	0	0	0	228	100.0	0	0	0	0	228	5.4
IV	0	0	0	0	0	0	0	0	991	98.2	0	0.7	991	23.6
Unknown	0	0	0	0	0	0	0	0	4	0.4	293	99.3	297	7.1
Total	502	100.0	1136	100.0	1025	100.0	228	100.0	1009	100.0	293	100.0	4193	100.0

Table 4.2-21 Age at diagnosis (in years) by pre-operative stage of disease (colon cancer)

Pre-operative stage	Age at diagnosis (years)															
	<40		40-49		50-59		60-69		70-79		>=80		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
I	5	6.3	11	6.5	53	12.1	123	12.1	191	13.6	118	10.9	2	18.2	503	12.0
II	19	24.1	36	21.3	108	24.7	267	26.3	399	28.4	310	28.8	0	0	1139	27.2
III	22	27.8	57	33.7	117	26.8	259	25.5	347	24.7	230	21.3	3	27.3	1035	24.7
Non-metastatic NOS	3	3.8	1	0.6	11	2.5	27	2.7	62	4.4	121	11.2	3	27.3	228	5.4
IV	26	32.9	52	30.8	124	28.4	274	27.0	301	21.4	212	19.7	2	18.2	991	23.6
Unknown	4	5.1	12	7.1	24	5.5	64	6.3	105	7.5	87	8.1	1	9.1	297	7.1
Total	79	100.0	169	100.0	437	100.0	1014	100.0	1405	100.0	1078	100.0	11	100.0	4193	100.0

Table 4.2-22 Gender by pre-operative stage of disease (colon cancer)

Pre-operative stage	Gender					
	Female		Male			
	N	%	N	%	Total	%
I	267	12.4	236	11.6	503	12.0
II	595	27.6	544	26.7	1139	27.2
III	532	24.7	503	24.7	1035	24.7
Non-metastatic NOS	135	6.3	93	4.6	228	5.4
IV	472	21.9	519	25.5	991	23.6
Unknown	154	7.1	143	7.0	297	7.1
Total	2155	100.0	2038	100.0	4193	100.0

Table 4.2-23 Rurality of residence at diagnosis by pre-operative stage of disease (colon cancer)

Pre-operative stage	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
I	324	11.1	111	15.3	58	12.8	10	9.6	503	12.0
II	805	27.6	192	26.5	123	27.2	19	18.3	1139	27.2
III	707	24.3	183	25.3	124	27.4	21	20.2	1035	24.7
Non-metastatic NOS	182	6.3	28	3.9	14	3.1	4	3.8	228	5.4
IV	692	23.8	171	23.6	117	25.8	11	10.6	991	23.6
Unknown	202	6.9	39	5.4	17	3.8	39	37.5	297	7.1
Total	2912	100.0	724	100.0	453	100.0	104	100.0	4193	100.0

Table 4.2-24 Distance from residence to the health facility at the time of diagnosis by pre-operative stage of disease (colon cancer)

Pre-operative stage	Distance from residence to facility of diagnosis (km)													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
I	169	11.7	104	12.2	74	11.4	91	13.3	54	12.1	11	9.8	503	12.0
II	413	28.5	233	27.3	174	26.8	172	25.2	127	28.3	20	17.9	1139	27.2
III	350	24.2	216	25.4	154	23.7	175	25.7	117	26.1	23	20.5	1035	24.7
Non-metastatic NOS	79	5.5	62	7.3	36	5.5	34	5.0	13	2.9	4	3.6	228	5.4
IV	334	23.1	203	23.8	162	24.9	171	25.1	106	23.7	15	13.4	991	23.6
Unknown	104	7.2	34	4.0	50	7.7	39	5.7	31	6.9	39	34.8	297	7.1
Total	1449	100.0	852	100.0	650	100.0	682	100.0	448	100.0	112	100.0	4193	100.0

Table 4.2-25 NZ Deprivation Index (quintile) of residence by pre-operative stage of disease (colon cancer)

Pre-operative stage	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
I	107	13.4	101	12.6	121	13.2	97	11.5	64	9.0	13	10.2	503	12.0
II	205	25.7	210	26.3	252	27.6	250	29.7	199	28.0	23	18.1	1139	27.2
III	207	25.9	209	26.1	220	24.1	208	24.7	165	23.2	26	20.5	1035	24.7
Non-metastatic NOS	39	4.9	49	6.1	45	4.9	41	4.9	47	6.6	7	5.5	228	5.4
IV	192	24.1	186	23.3	217	23.7	192	22.8	188	26.4	16	12.6	991	23.6
Unknown	48	6.0	45	5.6	59	6.5	55	6.5	48	6.8	42	33.1	297	7.1
Total	798	100.0	800	100.0	914	100.0	843	100.0	711	100.0	127	100.0	4193	100.0

Table 4.2-26 Prioritised ethnicity by pre-operative stage of disease (colon cancer)

Pre-operative stage	Prioritised ethnicity: Māori N	Māori %	Pacific N	Pacific %	nMnP N	nMnP %	Unknown N	Unknown %	Total	%
I	30	9.7	5	5.8	462	12.2	6	33.3	503	12.0
II	68	21.9	17	19.8	1048	27.7	6	33.3	1139	27.2
III	76	24.5	26	30.2	930	24.6	3	16.7	1035	24.7
Non-metastatic NOS	9	2.9	6	7.0	213	5.6	0	0	228	5.4
IV	98	31.6	30	34.9	862	22.8	1	5.6	991	23.6
Unknown	29	9.4	2	2.3	264	7.0	2	11.1	297	7.1
Total	310	100.0	86	100.0	3779	100.0	18	100.0	4193	100.0

4.2.3.2 Rectal cancer

Rectal cancer staging is more complex because many of the patients have chemotherapy or radiotherapy before their initial surgery. In this report we have therefore used the pre-operative stage variable to classify patients into groups for examining the patient journey.

Overall 76% of the patients with rectal cancer presented with non-metastatic disease (Table 4.2-27). Of these 1066 patients, 7 were found to have metastatic disease by the time they had surgery to provide pathology.

The proportion diagnosed with stage IV disease was smaller for older patients (34% of those aged over 70 years compared with 40% of those under 50). There was no difference between men and women in the proportion diagnosed with metastatic rectal cancer vs. non-metastatic. There were no clear patterns in the stage distribution by rurality, distance from the health facility of diagnosis or deprivation score, but a greater proportion of Māori patients was diagnosed with metastatic disease (29% compared with 22% for Pacific patients and 18% for nMnP patients).

Table 4.2-27 Staging of rectal cancer patients: comparison of pre-operative and post-operative stage

Pre-operative stage	Post–operative stage							
	Stage I-III		Stage IV		Unknown			
	N	%	N	%	N	%	Total	%
Non-metastatic	1055	99.7	7	2.5	4	6.1	1066	76.1
Metastatic	0	0	270	97.5	1	1.5	271	19.3
Unknown	3	0.3	0	0	61	92.4	64	4.6
Total	1058	100.0	277	100.0	66	100.0	1401	100.0

Table 4.2-28 Age at diagnosis (in years) by pre-operative stage of disease (rectal cancer)

Pre-operative stage	Age at diagnosis (years)															
	<40		40-49		50-59		60-69		70-79		>=80		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Non-metastatic	22	73.3	73	80.2	163	71.5	315	78.6	305	75.1	187	77.3	1	33.3	1066	76.1
Metastatic	7	23.3	15	16.5	58	25.4	78	19.5	74	18.2	38	15.7	1	33.3	271	19.3
Unknown	1	3.3	3	3.3	7	3.1	8	2.0	27	6.7	17	7.0	1	33.3	64	4.6
Total	30	100.0	91	100.0	228	100.0	401	100.0	406	100.0	242	100.0	3	100.0	1401	100.0

Table 4.2-29 Gender by pre-operative stage of disease (rectal cancer)

Pre-operative stage	Gender					
	Female		Male			
	N	%	N	%	Total	%
Non-metastatic	400	76.2	666	76.0	1066	76.1
Metastatic	103	19.6	168	19.2	271	19.3
Unknown	22	4.2	42	4.8	64	4.6
Total	525	100.0	876	100.0	1401	100.0

Table 4.2-30 Rurality of residence at diagnosis by pre-operative stage of disease (rectal cancer)

Pre-operative stage	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Non-metastatic	738	76.6	174	78.7	135	75.4	19	50.0	1066	76.1
Metastatic	180	18.7	42	19.0	40	22.3	9	23.7	271	19.3
Unknown	45	4.7	5	2.3	4	2.2	10	26.3	64	4.6
Total	963	100.0	221	100.0	179	100.0	38	100.0	1401	100.0

Table 4.2-31 Distance from residence to the health facility at the time of diagnosis by pre-operative stage of disease (rectal cancer)

Pre-operative stage	Distance from residence to facility of diagnosis (km): 0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Non-metastatic	364	77.0	208	75.6	160	76.6	195	79.9	115	73.7	24	54.5	1066	76.1
Metastatic	85	18.0	52	18.9	40	19.1	46	18.9	38	24.4	10	22.7	271	19.3
Unknown	24	5.1	15	5.5	9	4.3	3	1.2	3	1.9	10	22.7	64	4.6
Total	473	100.0	275	100.0	209	100.0	244	100.0	156	100.0	44	100.0	1401	100.0

Table 4.2-32 NZ Deprivation Index (quintile) of residence by pre-operative stage of disease (rectal cancer)

Pre-operative stage	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Non-metastatic	200	75.5	219	80.8	228	81.4	211	74.8	183	70.9	25	55.6	1066	76.1
Metastatic	48	18.1	44	16.2	42	15.0	62	22.0	65	25.2	10	22.2	271	19.3
Unknown	17	6.4	8	3.0	10	3.6	9	3.2	10	3.9	10	22.2	64	4.6
Total	265	100.0	271	100.0	280	100.0	282	100.0	258	100.0	45	100.0	1401	100.0

Table 4.2-33 Prioritised ethnicity by pre-operative stage of disease (rectal cancer)

Pre-operative stage	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Non-metastatic	91	66.9	43	72.9	928	77.2	4	100.0	1066	76.1
Metastatic	40	29.4	13	22.0	218	18.1	0	0	271	19.3
Unknown	5	3.7	3	5.1	56	4.7	0	0	64	4.6
Total	136	100.0	59	100.0	1202	100.0	4	100.0	1401	100.0

4.2.4 Key points: Demographic characteristics

74% of the PIPER patients were diagnosed with colon cancer and 25% with rectal cancer (1% unknown)

- The proportions with rectal cancer (compared to colon cancer) were higher for Māori and Pacific patients (30% and 41% respectively) than for nMnP patients.
- Colon cancer is slightly more common in females than males; rectal cancer is almost twice as common in males as females.
- Rectal cancer has a younger median age at presentation than colon cancer.

Māori and Pacific patients have higher deprivation index than nMnP, and those with the highest deprivation index also have the highest proportion who presented with metastatic disease.

Pacific patients are mostly urban, and whilst most Māori live in urban and independent urban areas, Māori have the highest proportion of their population living in rural areas.

- Māori have the highest proportion of people living >20km from facility of diagnosis (37% compared to 27% nMnP); Pacific patients have the highest proportion living <10km from facility of diagnosis (46% compared to 34% nMnP)
- Rural patients have a younger median age at presentation, although this has not been corrected for population characteristics or ethnicity.

The overall stage distribution for colon cancer in this cohort is:

- Stage I: 12%
- Stage II: 27%
- Stage III: 25%
- Stage IV: 24%
- Non-metastatic (not otherwise stated) 5%; Unknown: 7%

The overall stage distribution for rectal cancer in this cohort is:

- Non-metastatic (stage I-III): 76%
- Stage IV: 19%
- Unknown: 5%

Older patients are slightly less likely to present with metastatic disease than younger patients.

There is no gender difference between proportions with metastatic disease

Rural patients are slightly more likely to present with metastatic disease, although are also younger. Those who live >50km from the health facility of diagnosis are slightly more likely to present with metastatic disease than those living closer. Māori and Pacific are more likely to present with metastatic disease than nMnP (29% and 22% compared to 18%). Age at diagnosis is likely to be influencing these comparisons, and this plus the complex relationships between ethnicity, rurality and distance will be examined in our second phase of analysis.

4.2.5 Discussion: Demographic characteristics

The stage of CRC at diagnosis is the single most powerful prognostic variable, and is the principal determinant of treatment.

NZ has a relatively higher proportion of patients diagnosed with stage IV (metastatic) disease than other territories.

In the SEER database, 40% of cases are stage I or II, 36% stage III, 20% stage IV, and 5% unknown. The PIPER cohort has a higher proportion of stage IV cancers, but a similar proportion of "non-metastatic" cancers, although the comparison is complicated by 7% of cases being non-metastatic but not further characterised.

The proportion of stage IV colon cancers in Australia is 19%, and 17% for rectal cancer, which are both lower than NZ. In the UK 17% of both colon and rectal cancer presents as stage IV.[8]

The stage distribution seen in NZ is that of an unscreened population, with the lowest proportion of cancers being stage I. Results from population screening trials demonstrate that the proportion of stage I CRCs increases with screening, and this is also seen when programmes are introduced to the general population, with the proportions with stage I cancer increasing by 4-6% when screening is introduced, some areas having up to 18% stage I cancers.[9]

The Ministry of Health is currently running a Bowel Screening pilot in Waitemata DHB which is due to complete in 2015. If rolled out nationally, this is likely to impact on the overall stage distribution.

The staging system used by the American Joint Committee on Cancer (AJCC) has been updated since the PIPER cohort. The 7th edition was published in 2010, [29] and the sixth edition was in use in 2007-2008. The definitions of T1-4, N1-2 and Stages 1-4 have not changed between versions 6 and versions 7. There has been the elaboration of T4 into T4a (tumour present on serosal surface) to T4b (tumour invading adjacent organs). Stage IIC has been developed, and comprises T4bN0M0.

AJCC version 7 has improved prognostic accuracy for some subclasses. Analysis in PIPER is restricted to the four core AJCC stages (I-IV) and therefore is not affected by the changes in subclasses between versions 6 and 7.

Previous research has shown that although Māori have a lower incidence of colon and rectal cancer than non-Māori, the incidence in Māori has been rising much more quickly than in non-Māori, and the gap between Māori and non-Māori has been reducing rapidly. [4] Data on Pacific patients is more scarce.[21] The PIPER cohort demonstrates that a high proportion of Māori and Pacific patients diagnosed with CRC present with advanced stage disease.

4.3 Colon Cancer: Presentation to hospital care

4.3.1 Key performance indicators (KPIs) for presentation for colon cancer

The key performance indicators we have used for presentation to hospital care are:

1. Emergency presentation into hospital care
2. Evidence of bowel obstruction at presentation

Presentation to the Emergency Department (ED) as the path leading to the diagnosis of CRC may be a surrogate measure for late presentation, severe symptoms, or the need for emergency surgery. Presentation to hospital care through the ED rather than outpatient referral may suggest barriers to or within primary care. Overall 36% of lung cancer patients in NZ present via the ED, with higher proportions for those of Pacific ethnicity.[30] The UK National Bowel Cancer audit reported that 21% of patients presented as an emergency with CRC, but did not report by colon and rectal cancer separately.

CRC presenting with bowel obstruction is recognised to be associated with poor prognosis, although is not specifically listed as a prognostic variable in the AJCC staging manual version 6. Bowel obstruction is associated with a survival decrement of as much as 25% at 5 years. This persists in most studies in multivariate analyses. [31] It has been suggested that obstructed right sided tumours may have worse outcome than obstructed tumours at other primary tumour sites although this has not been demonstrated consistently across studies.

Both bowel obstruction and emergency presentation are associated with emergency surgery. Those who undergo emergency surgery in the UK have a mortality of 9.2% compared to 2.1% for those who undergo elective resection. [7] Understanding the rates of emergency presentation and bowel obstruction and analysing factors associated with emergency and late presentation may lead to a reduction in morbidity and mortality from colon and rectal cancer.

4.3.2 PIPER analysis cohorts for colon cancer

Of the 5667 patients in the total PIPER cohort, review of the hospital notes found one patient diagnosed during 2005, four diagnosed during 2010 and one diagnosed during 2012 (Table 4.3-1). For a further 19 patients the year of diagnosis was unknown. In addition, for 65 patients the site of the primary tumour was unknown. For those 65 patients much of the clinical data is missing, so they were excluded from further analysis.

Table 4.3-1 Site of primary tumour by year of diagnosis as extracted from the clinical notes in the PIPER study

PIPER year of diagnosis	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
2005	1	0.0	0	0	0	0	1	0.0
2006	215	5.1	89	6.4	5	6.8	309	5.5
2007	1825	43.5	632	45.1	24	32.9	2481	43.8
2008	1892	45.1	571	40.8	19	26.0	2482	43.8
2009	249	5.9	104	7.4	17	23.3	370	6.5
2010	3	0.1	1	0.1	0	0	4	0.1
2012	0	0	1	0.1	0	0	1	0.0
Unknown	8	0.2	3	0.2	8	11.0	19	0.3
Total	**4193**	**100.0**	**1401**	**100.0**	**73**	**100.0**	**5667**	**100.0**

4.3.3 Presentation to hospital care for colon cancer

4.3.3.1 Rurality for colon cancer

There were 3717 patients diagnosed with colon cancer in the years 2007 and 2008. Of these, rurality of residence at diagnosis was unknown for 83. These 83 patients are excluded from the analyses in this section.

The overall proportion of patients presenting to hospital care as an emergency was 34% (95% CI: 33 to 36) (Table 4.3-2). The proportion did not differ by rurality (p=0.7). The overall proportion presenting with obstruction was 22% (95% CI: 20 to 23), however the proportion presenting with obstruction was higher for those from independent urban areas than urban or rural areas (p=0.0003) (Table 4.3-3). There were differences in the characteristics of patients between urban and rural areas, for example age and comorbidity and ethnicity, which may influence this comparison, and this will be examined in the second phase of analysis.

The majority of patients presented to a surgical service (60%, 95% CI: 59 to 62); the next most common was gastroenterology (25%, 95% CI: 24to 27) (Table 4.3-4). Urban patients were much more likely to be seen initially by a gastroenterologist (29%) than independent urban (16%) or rural patients (20%). Whereas for independent urban and rural patients their initial specialist was more likely to be a surgeon (73% and 69% respectively compared with 59% for urban patients). This is likely to be reflect the particular services available. The method of diagnosis will be examined in further sections of the report.

Table 4.3-2 Emergency presentation into hospital care by rurality (p-value calculation excludes unknowns)

Emergency presentation into hospital care	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value*
Yes	876	33.9	233	35.7	131	33.2	1240	34.1	0.7
No	1583	61.2	398	60.9	249	63.2	2230	61.4	
Unknown	128	4.9	22	3.4	14	3.6	164	4.5	
Total	2587	100.0	653	100.0	394	100.0	3634	100.0	

Table 4.3-3 Evidence of obstruction at presentation into hospital care by rurality (p-value calculation excludes unknowns)

Evidence of obstruction	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	528	20.4	182	27.9	83	21.1	793	21.8	0.0003
No	1954	75.5	449	68.8	295	74.9	2698	74.2	
Unknown	105	4.1	22	3.4	16	4.1	143	3.9	
Total	2587	100.0	653	100.0	394	100.0	3634	100.0	

Table 4.3-4 Department undertaking first specialist assessment by rurality (p-value calculation excludes unknowns)

Department undertaking FSA - final field	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value*
Surgical	1445	55.9	474	72.6	272	69.0	2191	60.3	<0.0001
Gastroenterology	738	28.5	106	16.2	77	19.5	921	25.3	
General Medicine	312	12.1	55	8.4	35	8.9	402	11.1	
Medical Oncology	18	0.7	3	0.5	2	0.5	23	0.6	
Other medical specialty	20	0.8	4	0.6	1	0.3	25	0.7	
Emergency Department	12	0.5	3	0.5	0	0	15	0.4	
Obstetrics & Gynaecology	9	0.3	1	0.2	2	0.5	12	0.3	
Other surgical specialty	3	0.1	1	0.2	1	0.3	5	0.1	
Radiation Oncology	2	0.1	1	0.2	1	0.3	4	0.1	
Unknown	28	1.1	5	0.8	3	0.8	36	1.0	
Total	2587	100.0	653	100.0	394	100.0	3634	100.0	

*p-value is calculated on a table with Medical Oncology to Radiation Oncology grouped as Other

4.3.3.2 Distance from health facility of diagnosis for colon cancer

Of the 3717 patients diagnosed with colon cancer in the year 2007 and 2008, distance from the health facility of diagnosis to the meshblock (defined area) of their residence at the time of diagnosis could not be calculated for 89 patients.

There was no difference in the proportion presenting as an emergency by distance from health facility of diagnosis (p=0.9) (Table 4.3-5). There was some evidence of a difference in the proportion presenting with obstruction with different distance from the diagnostic facility, however the proportion did not increase with increasing distance from the diagnostic facility (Table 4.3-6). The groups with the lowest proportions presenting with obstruction were those living 5-10 and 10-20 kms away from the diagnostic facility (19% and 18% respectively, compared with 23% or over in the other areas, p=0.005). These areas 10-20 km away also had a higher number of patients who presented to gastroenterology (p<0.0001) (Table 4.3-7). The proportion was 30% for those 10-20km away compared with 25% or less for the remainder.

Table 4.3-5 Emergency presentation into hospital care by distance of residence from health facility of diagnosis (p-value calculation excludes unknowns)

Emergency presentation into hospital care	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	451	34.8	255	33.4	185	32.5	214	35.3	134	33.9	1239	34.2	0.9
No	790	61.0	476	62.4	347	61.0	369	60.9	247	62.5	2229	61.4	
Unknown	54	4.2	32	4.2	37	6.5	23	3.8	14	3.5	160	4.4	
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0	

Table 4.3-6 Evidence of obstruction at presentation into hospital care by distance of residence from health facility of diagnosis (p-value calculation excludes unknowns)

Evidence of obstruction	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	295	22.8	146	19.1	102	17.9	158	26.1	91	23.0	792	21.8	0.005
No	953	73.6	589	77.2	442	77.7	433	71.5	279	70.6	2696	74.3	
Unknown	47	3.6	28	3.7	25	4.4	15	2.5	25	6.3	140	3.9	
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0	

Table 4.3-7 Department undertaking the first specialist assessment by distance of residence from health facility of diagnosis (p-value calculation excludes unknowns)

Department undertaking FSA – final field	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value*
Surgical	806	62.2	441	57.8	308	54.1	372	61.4	263	66.6	2190	60.4	<0.0001
Gastroenterology	308	23.8	197	25.8	173	30.4	154	25.4	88	22.3	920	25.4	
General Medicine	148	11.4	93	12.2	65	11.4	64	10.6	31	7.8	401	11.1	
Medical Oncology	8	0.6	5	0.7	5	0.9	2	0.3	3	0.8	23	0.6	
Other medical specialty	6	0.5	8	1.0	4	0.7	5	0.8	2	0.5	25	0.7	
Emergency Department	3	0.2	7	0.9	1	0.2	2	0.3	2	0.5	15	0.4	
Obstetrics & Gynaecology	4	0.3	2	0.3	3	0.5	1	0.2	2	0.5	12	0.3	
Other surgical specialty	2	0.2	0	0	0	0	3	0.5	0	0	5	0.1	
Radiation Oncology	3	0.2	0	0	0	0	1	0.2	0	0	4	0.1	
Unknown	7	0.5	10	1.3	10	1.8	2	0.3	4	1.0	33	0.9	
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0	

*p-value is calculated on a table with Medical Oncology to Radiation Oncology grouped as Other

4.3.3.3 Area of deprivation of residence at diagnosis for colon cancer

Of the 3717 patients diagnosed with colon cancer in the years 2007 and 2008 the NZ Deprivation Index of their residence at diagnosis was unknown for 104 patients. These 104 patients are excluded from this section.

The proportion of patients presenting as an emergency increased with higher deprivation, from 29% in the highest quintile to 43% in the lowest quintile ($p<0.0001$) (Table 4.3-8). The proportion presenting with obstruction did increase with increasing deprivation (from 19% to 25%) but the differences in proportions were not statistically significant overall ($p=0.2$) (Table 4.3-9). Patients in lower deprivation areas were more likely to have been seen first by a gastroenterologist (30% of quintile 1-2 patients compared with 19% of quintile 9-10, $p=0<0.0001$) (Table 4.3-10).

Table 4.3-8 Emergency presentation into hospital care by NZ Deprivation Index quintile (p-value calculation excludes unknowns)

Emergency presentation into hospital care	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	210	29.3	229	31.4	278	33.6	255	34.3	258	43.4	1230	34.0	<0.0001
No	461	64.3	458	62.7	518	62.6	466	62.6	317	53.4	2220	61.4	
Unknown	46	6.4	43	5.9	32	3.9	23	3.1	19	3.2	163	4.5	
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0	

*The NZ Deprivation Index is an area measure of deprivation. Higher values index indicate greater deprivation.

Table 4.3-9 Evidence of obstruction at presentation into hospital care by NZ Deprivation Index quintile (p-value calculation excludes unknowns)

Evidence of obstruction	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	136	19.0	154	21.1	184	22.2	167	22.4	150	25.3	791	21.9	0.2
No	542	75.6	540	74.0	611	73.8	558	75.0	429	72.2	2680	74.2	
Unknown	39	5.4	36	4.9	33	4.0	19	2.6	15	2.5	142	3.9	
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0	

Table 4.3-10 Department undertaking first specialist assessment by NZ Deprivation Index quintile (p-value calculation excludes unknowns)

Department undertaking FSA – final field	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value*
Surgical	421	58.7	423	57.9	497	60.0	462	62.1	376	63.3	2179	60.3	<0.0001
Gastroenterology	213	29.7	206	28.2	209	25.2	175	23.5	114	19.2	917	25.4	
General Medicine	60	8.4	74	10.1	95	11.5	88	11.8	81	13.6	398	11.0	
Medical Oncology	6	0.8	7	1.0	4	0.5	3	0.4	3	0.5	23	0.6	
Other medical specialty	4	0.6	4	0.5	6	0.7	5	0.7	6	1.0	25	0.7	
Emergency Department	3	0.4	2	0.3	3	0.4	3	0.4	4	0.7	15	0.4	
Obstetrics & Gynaecology	0	0	5	0.7	5	0.6	1	0.1	1	0.2	12	0.3	
Other surgical specialty	0	0	1	0.1	1	0.1	0	0	3	0.5	5	0.1	
Radiation Oncology	0	0	1	0.1	1	0.1	0	0	2	0.3	4	0.1	
Unknown	10	1.4	7	1.0	7	0.8	7	0.9	4	0.7	35	1.0	
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0	

*p-value is calculated on a table with Medical Oncology to Radiation Oncology grouped as Other

4.3.3.4 Ethnicity for colon cancer

For the description of presentation for ethnicity we used the extended PIPER cohort. There were 4181 patients in this cohort who were diagnosed with colon cancer in 2006-2009, but ethnicity was unknown for 18, leaving 4,163 patients to be included in the analysis.

The proportion of Māori patients who presented as an emergency was 44%, and for Pacific patients it was 51%. For nMnP the proportion was 33% (p<0.0001). The proportion of patients presenting with obstruction was similar in all three ethnic groups (21-24%). Māori patients were much less like to have been assessed first by a gastroenterologist (18%, compared with 33% for Pacific patients and 26% for nMnP patients (p=0.01).

Table 4.3-11 Emergency presentation into hospital care by prioritised ethnicity

Emergency presentation into hospital care	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	136	44.0	43	51.2	1235	32.8	1414	34.0	p<0.0001
No	161	52.1	40	47.6	2305	61.1	2506	60.2	
Unknown	12	3.9	1	1.2	230	6.1	243	5.8	
Total	309	100.0	84	100.0	3770	100.0	4163	100.0	

Table 4.3-12 Evidence of obstruction at presentation by prioritised ethnicity

Evidence of obstruction	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	73	23.6	18	21.4	793	21.0	884	21.2	p=0.7
No	229	74.1	65	77.4	2768	73.4	3062	73.6	
Unknown	7	2.3	1	1.2	209	5.5	217	5.2	
Total	309	100.0	84	100.0	3770	100.0	4163	100.0	

Table 4.3-13 Department undertaking first specialist assessment by prioritised ethnicity

Department undertaking FSA - final field	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Surgical	200	64.7	43	51.2	2220	58.9	2463	59.2	0.01
Gastroenterology	55	17.8	28	33.3	982	26.0	1065	25.6	
General Medicine	41	13.3	13	15.5	402	10.7	456	11.0	
Medical Oncology	4	1.3	0	0	22	0.6	26	0.6	
Other medical specialty	2	0.6	0	0	27	0.7	29	0.7	
Emergency Department	1	0.3	0	0	15	0.4	16	0.4	
Obstetrics & Gynaecology	3	1.0	0	0	10	0.3	13	0.3	
Other surgical specialty	1	0.3	0	0	4	0.1	5	0.1	
Radiation Oncology	0	0	0	0	4	0.1	4	0.1	
Unknown	2	0.6	0	0	84	2.2	86	2.1	
Total	309	100.0	84	100.0	3770	100.0	4163	100.0	

*p-value is calculated on a table with Medical Oncology to Radiation Oncology grouped as Other

4.3.4 Key points: for presentation for colon cancer

Emergency presentation into hospital care:

- 34% of patients with colon cancer presented to the ED as mode of first presentation.
- 44% of Māori and 51% of Pacific patients presented via ED, compared to 33% nMnP ($p<0.0001$)
- Independent urban patients had a slightly higher proportion presenting as an emergency (36%) compared to urban (34%) and rural (33%)
- Distance to health facility of diagnosis was not associated with emergency presentation
- The proportion of patients presenting as an emergency increased with higher deprivation (29% of Dep1-2 increasing across quintiles to 43% of Dep9-10; $p=0.0001$)

Presentation with obstruction:

- 22% of patients with colon cancer presented with evidence of obstruction
- Independent urban patients were most likely to present with obstruction (28% for independent urban, 20% for urban, 21% rural; $p=0.0003$).
- there was a statistically significant association between distance to health facility of diagnosis and presentation with obstruction, with those living 5-20km from health facility of diagnosis being most likely to present obstructed. ($p=0.005$)
- Although 51% of Pacific patients present via the ED, 21% had obstruction
- Māori were slightly more likely to present with obstruction, although the differences were not statistically significant in this provisional and unadjusted analysis.

First specialist assessment:

- 60% of patients with colon cancer are diagnosed following a first specialist assessment (FSA) with a surgical department, and 25% through gastroenterology
- there was a statistically significant association between department of FSA and distance to health facility of diagnosis, with those living 10-20km from health facility of diagnosis being most likely to be diagnosed via gastroenterology. The same statistically significant pattern is seen with rectal cancer diagnoses.
- there was a statistically significant association between deprivation and department of FSA, with the proportion seen by a gastroenterologist decreasing with higher levels of deprivation.
- The proportion of patients diagnosed via surgical FSA increased slightly across quintiles (Dep 1-2, 59%; Dep9-10, 63%; $p<0.0001$)

4.3.5 Discussion: for presentation for colon cancer

The proportion of patients presenting to the ED in NZ is notably higher than in the UK, with 34% of patients with colon cancer presenting this way compared to 21% in the UK. [7] A higher proportion of Māori and Pacific patients present via ED compared to nMnP. Whilst Māori have a slightly higher proportion presenting with obstruction than nMnP, this does not appear to account for the difference in proportions presenting via ED.

These results have not yet been adjusted for age or gender, and further analyses will be undertaken to help clarify the potential relationships between emergency presentation, site of primary tumour, ethnicity, rurality and deprivation.

There is a clear difference between the proportion of colon cancer and rectal cancer presenting via the ED (data presented in section 4.7.3). Care in the ED is free of charge whereas primary care often carries an associated part charge. It may be plausible to consider whether more deprived groups may preferentially use ED as a subsidised substitute for their GP. However if this were the case, it could be expected to see a similar proportion of patients with rectal cancer presenting to the ED as colon cancer. As this is not seen, it may suggest that other factors are at play.

The UK National Bowel Cancer Audit reports proportions presenting as emergency rather than presenting as obstruction. Whilst definitive comparators are not available, estimates vary between 8-29% of colon cancer cases presenting with obstruction.[32] Rates of emergency presentation in the UK vary by region, and this may be reflective of lack of screening, inadequacies in diagnostic services, or late engagement of patients with health-care providers. Emergency presentation could be highlighted as a variable for further study.

It remains unclear whether the adverse prognosis associated with bowel obstruction is associated with disease characteristics or whether the obstruction itself promotes metastatic spread. A single institution prospective database reported that patients with CRC and malignant obstruction treated with stents compared to those going directly to surgery had similar overall survival (30 v 31 months).[33] This may suggest that measures to ameliorate

obstruction may impact on need for emergency surgery but do not reduce cancer-related mortality. Further efforts to detect colon cancer prior to obstruction are clearly warranted.

It is of note that our unadjusted analyses show differences in rates of presentation to ED and with obstruction by rurality, distance to health facility of diagnosis, deprivation, and ethnicity. Disentangling the likely complex interrelations between these factors is beyond the scope of the currently funded project, but subsequent work is already planned to analyse this further.

Highlights: Colon Cancer

Presentation to hospital care

34% of patients with colon cancer presented via ED

22% of patients with colon cancer presented with bowel obstruction with 28% of independent urban patients having obstruction (unadjusted comparison)

Surgical Services were the first speciality seen by 60% of patients with colon cancer

Māori and Pacific patients were more likely to present to hospital care via ED than nMnP patients (unadjusted comparison)

4.4 Colon Cancer: Demographic and clinical characteristics of patients at diagnosis

4.4.1 Demographic characteristics for colon cancer

4.4.1.1 Rurality of residence at diagnosis for colon cancer

Of the 3717 patients with colon cancer, rurality of residence at diagnosis was unknown for 83, so 3634 patients are included in the analyses in this section.

Patients in rural areas tended to be younger than those from urban or independent urban areas. In particular, the proportions of patients over 80 years of age were 17% for rural areas, 28% for urban areas and 26% for independent urban areas (Table 4.4-1). This means that any differences in management by age may manifest as differences in management by rurality, so care needs to be take in interpretation. There was also a difference in the proportions of males and females in the urban/rural areas (Table 4.4-2). The proportions of females were 44% for rural, 54% for urban and 50% for independent urban.

The distribution of the comorbidity scores varied by rurality of the area of residence (Table 4.4-3). In rural areas only 10% of the patients had a comorbidity score of 3 or more, compared with 15% in urban areas and 17% in independent urban areas (Table 4.4-3).This may be reflecting the differences in age distribution.

Table 4.4-1 Age (in years) at diagnosis by rurality of residence at diagnosis for patients with colon cancer

	Rurality of residence at time of diagnosis							
Age at diagnosis	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
<40	45	1.7	5	0.8	7	1.8	57	1.6
40-49	95	3.7	14	2.1	13	3.3	122	3.4
50-59	255	9.9	56	8.6	51	12.9	362	10.0
60-69	580	22.4	154	23.6	126	32.0	860	23.7
70-79	880	34.0	247	37.8	131	33.2	1258	34.6
>=80	732	28.3	176	27.0	65	16.5	973	26.8
Unknown	0	0	1	0.2	1	0.3	2	0.1
Total	2587	100.0	653	100.0	394	100.0	3634	100.0

Table 4.4-2 Gender by rurality of residence at diagnosis for patients with colon cancer

Gender	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Female	1385	53.5	327	50.1	172	43.7	1884	51.8
Male	1202	46.5	326	49.9	222	56.3	1750	48.2
Total	2587	100.0	653	100.0	394	100.0	3634	100.0

Table 4.4-3 C3 comorbidity score by rurality of residence at diagnosis for patients with colon cancer

C3 comorbidity score*	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
0	1164	45.0	277	42.4	207	52.5	1648	45.3
>0-1	465	18.0	112	17.2	71	18.0	648	17.8
>1-2	370	14.3	96	14.7	52	13.2	518	14.3
>2-3	198	7.7	59	9.0	26	6.6	283	7.8
>3	390	15.1	109	16.7	38	9.6	537	14.8
Total	2587	100.0	653	100.0	394	100.0	3634	100.0

*High values indicate greater comorbidity

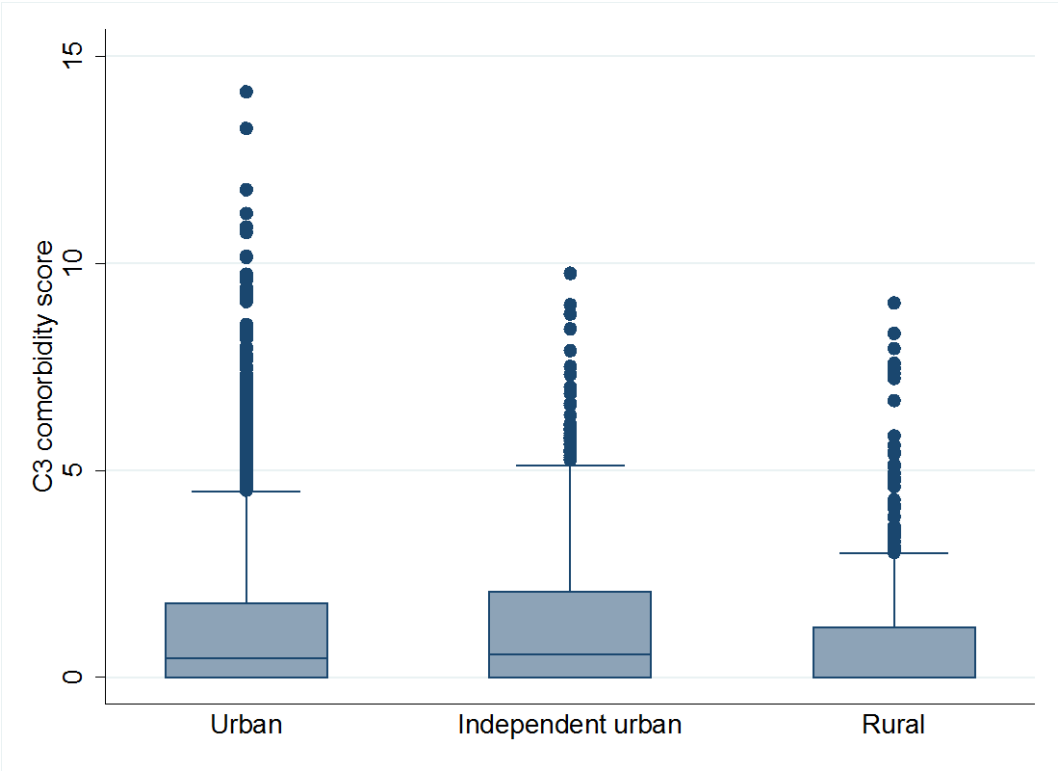

Figure 4.4-1 Baseline C3 comorbidity score by rurality for patients with colon cancer (note higher C3 comorbidity score values indicate greater comorbidity).

4.4.1.2 Distance from residence at diagnosis to health facility of diagnosis (colon cancer)

Of the 3717 patients with CRC, distance of residence at diagnosis from the health facility of diagnosis was unknown for 89, so 3628 patients are included in the analyses in this section.

Patients who lived further from the diagnostic facility tended to be a little younger, although the age differences were not large (Table 4.4-4). There were differences in gender by distance of residence from the diagnostic facility. In the areas within 5km away from the facility the proportion of males was 44%, whereas in those over 50km away the proportion was 54% (Table 4.4-5). There was little variation in comorbidity by distance from the diagnostic facility (Figure 4.4.2, Table 4.4-6).

Table 4.4-4 Age (in years) at diagnosis by distance of residence at diagnosis from the health facility of diagnosis for patients with colon cancer

Age at diagnosis	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
<40	22	1.7	10	1.3	10	1.8	8	1.3	7	1.8	57	1.6
40-49	51	3.9	28	3.7	22	3.9	13	2.1	8	2.0	122	3.4
50-59	107	8.3	88	11.5	65	11.4	61	10.1	39	9.9	360	9.9
60-69	298	23.0	158	20.7	131	23.0	149	24.6	123	31.1	859	23.7
70-79	428	33.1	266	34.9	204	35.9	223	36.8	134	33.9	1255	34.6
>=80	388	30.0	213	27.9	137	24.1	151	24.9	84	21.3	973	26.8
Unknown	1	0.1	0	0	0	0	1	0.2	0	0	2	0.1
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0

Table 4.4-5 Gender by distance of residence at diagnosis from the health facility of diagnosis for patients with colon cancer

Gender	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Female	722	55.8	406	53.2	278	48.9	294	48.5	182	46.1	1882	51.9
Male	573	44.2	357	46.8	291	51.1	312	51.5	213	53.9	1746	48.1
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0

Table 4.4-6 C3 comorbidity score by distance of residence at diagnosis from the health facility of diagnosis for patients with colon cancer

C3 comorbidity score	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
0	580	44.8	329	43.1	260	45.7	293	48.3	182	46.1	1644	45.3
>0-1	239	18.5	131	17.2	101	17.8	106	17.5	70	17.7	647	17.8
>1-2	189	14.6	110	14.4	81	14.2	91	15.0	47	11.9	518	14.3
>2-3	98	7.6	66	8.7	45	7.9	36	5.9	38	9.6	283	7.8
>3	189	14.6	127	16.6	82	14.4	80	13.2	58	14.7	536	14.8
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0

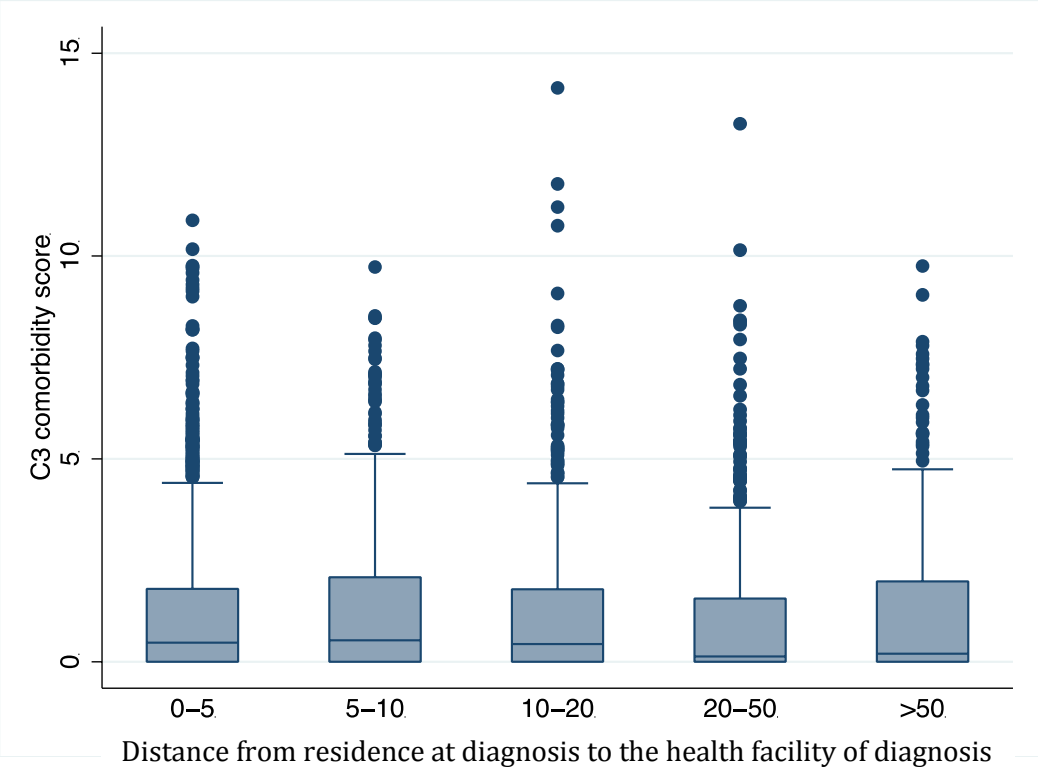

Figure 4.4-2 Baseline C3 comorbidity score by distance from residence at diagnosis to the health facility where their cancer was diagnosed for patients with colon cancer.

4.4.1.3 Area deprivation of residence at diagnosis (colon cancer)

Of the 3717 patients with CRC, area deprivation score of residence at diagnosis was unknown for 104, so 3613 patients are included in the analyses in this section.

The proportion of older patients was greater in areas with higher deprivation: in the least deprived quintile (1-2) 21% of the patients were aged over 80 years compared with 30% in the most deprived quintile (9-10) (Table 4.4-7). The proportions of males and females did not differ much by deprivation (Table 4.4-8).

The level of comorbidity varied by deprivation (Table 4.4-9); patients living in more deprived areas tended to have higher comorbidity scores (greater comorbidity). In the least deprived quintile (1-2) 12% of patients had a comorbidity score of 3 or more, compared with 21% in the areas with highest deprivation (9-10) (Table 4.4-9).

Table 4.4-7 Age (in years) at diagnosis by area deprivation of residence at diagnosis score for patients with colon cancer

Age at diagnosis	Deprivation index 2006											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
<40	19	2.6	8	1.1	6	0.7	12	1.6	12	2.0	57	1.6
40-49	35	4.9	28	3.8	27	3.3	17	2.3	15	2.5	122	3.4
50-59	78	10.9	82	11.2	74	8.9	66	8.9	62	10.4	362	10.0
60-69	196	27.3	187	25.6	185	22.3	170	22.8	122	20.5	860	23.8
70-79	238	33.2	243	33.3	306	37.0	260	34.9	206	34.7	1253	34.7
>=80	150	20.9	182	24.9	229	27.7	219	29.4	177	29.8	957	26.5
Unknown	1	0.1	0	0	1	0.1	0	0	0	0	2	0.1
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0

Table 4.4-8 Gender by area deprivation score of residence at diagnosis for patients with colon cancer

Gender	Deprivation index 2006											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Female	338	47.1	396	54.2	436	52.7	399	53.6	301	50.7	1870	51.8
Male	379	52.9	334	45.8	392	47.3	345	46.4	293	49.3	1743	48.2
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0

Table 4.4-9 C3 comorbidity score by area deprivation score of residence at diagnosis for patients with colon cancer

C3 comorbidity score	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
0	372	51.9	354	48.5	377	45.5	333	44.8	205	34.5	1641	45.4
>0-1	138	19.2	133	18.2	145	17.5	118	15.9	111	18.7	645	17.9
>1-2	82	11.4	98	13.4	128	15.5	107	14.4	98	16.5	513	14.2
>2-3	38	5.3	49	6.7	65	7.9	70	9.4	58	9.8	280	7.7
>3	87	12.1	96	13.2	113	13.6	116	15.6	122	20.5	534	14.8
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0

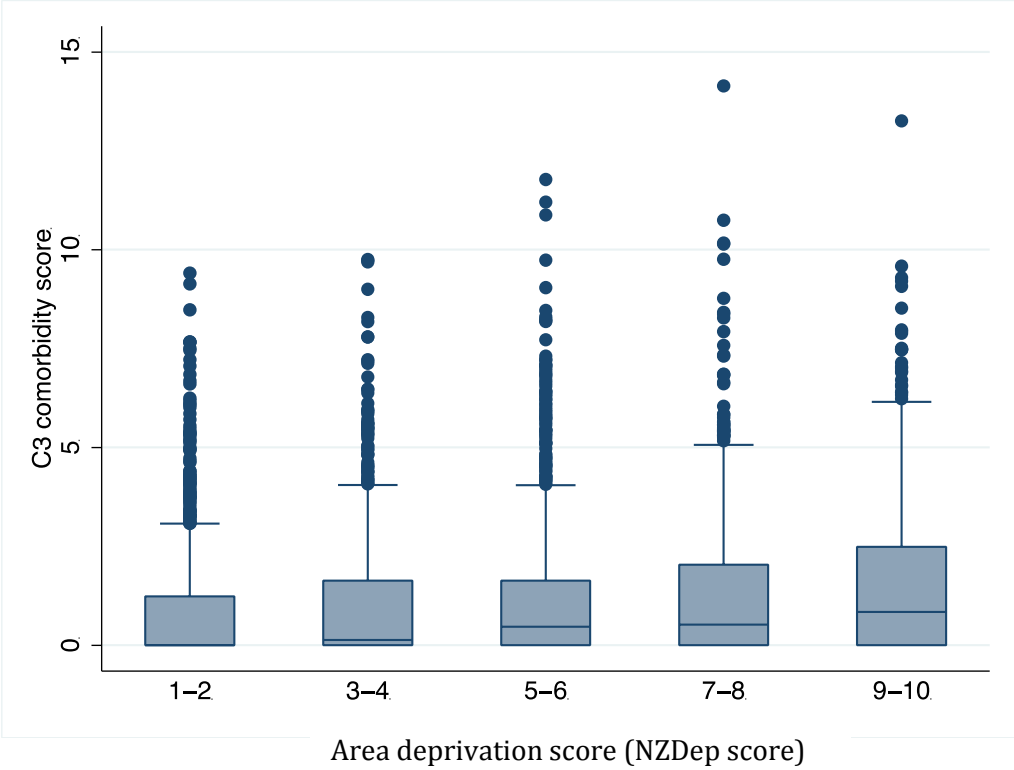

Figure 4.4-3 Baseline C3 comorbidity score by area deprivation score for patients with colon cancer.

4.4.1.4 Ethnicity for colon cancer

Of the 3717 patients with CRC, ethnicity was unknown for 16, so 3701 patients are included in the analyses in this section.

The proportion of older patients was higher in the nMnP (26%) than in the Māori (10%) and the Pacific (15%) groups (Table 4.4-10). There was a slightly higher proportion of females among the Māori patients compared with Pacific (56 vs. 46%). For nMnP the proportion of female patients was 52% (Table 4.4-11).

The level of comorbidity varied by ethnic group. The group of Pacific patients had the highest average comorbidity levels (Figure 4.4.4), although they had fewer patients with very high levels of comorbidity (Table 4.4-12). The group of Māori patients had slightly higher comorbidity levels than nMnP, but since Māori patients tended to be younger this difference is likely to become more extreme when age is taken into account.

Table 4.4-10 Age (in years) at diagnosis by ethnicity for patients with colon cancer

Age at diagnosis	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
<40	7	4.8	2	4.9	51	1.5	60	1.6
40-49	10	6.9	2	4.9	116	3.3	128	3.5
50-59	32	22.1	9	22.0	331	9.4	372	10.1
60-69	46	31.7	14	34.1	821	23.4	881	23.8
70-79	35	24.1	8	19.5	1226	34.9	1269	34.3
>=80	14	9.7	6	14.6	968	27.5	988	26.7
Unknown	1	0.7	0	0	2	0.1	3	0.1
Total	145	100.0	41	100.0	3515	100.0	3701	100.0

Table 4.4-11 Gender by ethnicity for patients with colon cancer

Gender	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Female	81	55.9	19	46.3	1821	51.8	1921	51.9
Male	64	44.1	22	53.7	1694	48.2	1780	48.1
Total	145	100.0	41	100.0	3515	100.0	3701	100.0

Table 4.4-12 C3 comorbidity score by ethnicity for patients with colon cancer

C3 comorbidity score	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
0	57	39.3	14	34.1	1621	46.1	1692	45.7
>0-1	29	20.0	7	17.1	621	17.7	657	17.8
>1-2	20	13.8	12	29.3	492	14.0	524	14.2
>2-3	13	9.0	2	4.9	271	7.7	286	7.7
>3	26	17.9	6	14.6	510	14.5	542	14.6
Total	145	100.0	41	100.0	3515	100.0	3701	100.0

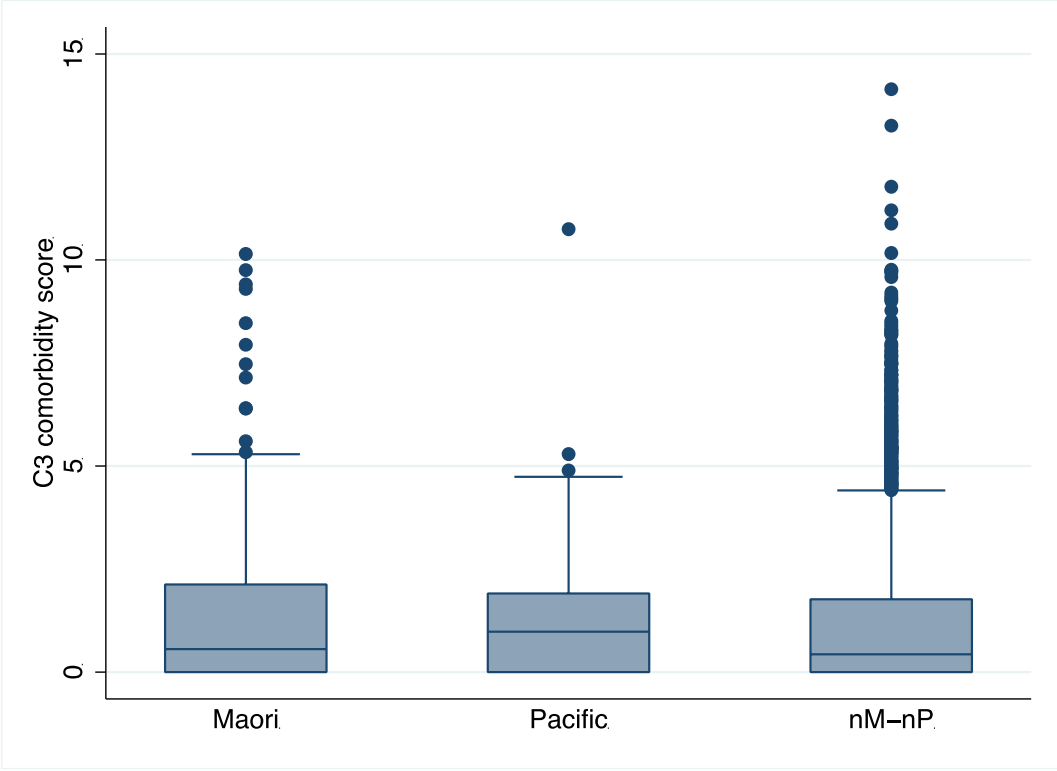

Figure 4.4-4 Baseline C3 comorbidity score by ethnicity for patients with colon cancer (note higher comorbidity scores indicate greater levels of comorbidity).

4.4.2 Clinical characteristics at diagnosis for colon cancer

4.4.2.1 Rurality of residence at diagnosis for colon cancer

The overall percentage of patients diagnosed with metastatic colon cancer was 23% (95% CI: 21 to 24) (Table 4.4-13). There was no difference in stage distribution by rurality of residence at diagnosis (p=0.7). However rural patients tended to be younger than the urban or independent urban patients, therefore on that basis it might be expected that they would have a lower proportion with metastatic disease. Such confounding by patient demographic characteristics will be addressed in the second phase of our analysis.

The overall proportion of patients with tumours on the right side (see methods section "Tumour location" for definition) was 51% (95% CI: 49 to 53) (Table 4.4-16). The proportions were similar in the three urban/rural groups (p=0.1). Left sided tumours were more common in men than women (54% vs. 42%) (Table 4.4-15). The proportions of left and right sided tumours presenting at metastatic were very similar (50% and 46% respectively (Table 4.4-16, Figure 4.4.5).

Table 4.4-13 Pre-operative stage by urban rural status for patients with colon cancer

	Diagnosis urban rural status								
Pre-op stage	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Non-metastatic	1811	70.0	471	72.1	281	71.3	2563	70.5	0.7
Metastatic	579	22.4	144	22.1	97	24.6	820	22.6	
Unknown	197	7.6	38	5.8	16	4.1	251	6.9	
Total	2587	100.0	653	100.0	394	100.0	3634	100.0	

Table 4.4-14 Tumour sidedness by urban rural status for patients with colon cancer

	Diagnosis urban rural status								
Tumour location	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Right	1339	51.8	318	48.7	192	48.7	1849	50.9	0.1
Left	1206	46.6	332	50.8	199	50.5	1737	47.8	
Unknown	42	1.6	3	0.5	3	0.8	48	1.3	
Total	2587	100.0	653	100.0	394	100.0	3634	100.0	

Table 4.4-15 Tumour sidedness by gender for patients with colon cancer

	Gender					
	Female		Male			
Tumour location	N	%	N	%	Total	%
Right	1074	57.0	775	44.3	1849	50.9
Left	786	41.7	951	54.3	1737	47.8
Unknown	24	1.3	24	1.4	48	1.3
Total	1884	100.0	1750	100.0	3634	100.0

Table 4.4-16 Tumour sidedness by pre-operative stage for patients with colon cancer

	Pre-operative stage							
Tumour location	Non-metastatic		Metastatic		Unknown			
	N	%	N	%	N	%	Total	%
Right	1327	51.8	374	45.6	148	59.0	1849	50.9
Left	1226	47.8	412	50.2	99	39.4	1737	47.8
Unknown	10	0.4	34	4.1	4	1.6	48	1.3
Total	2562	100.0	818	100.0	253	100.0	3633	100.0

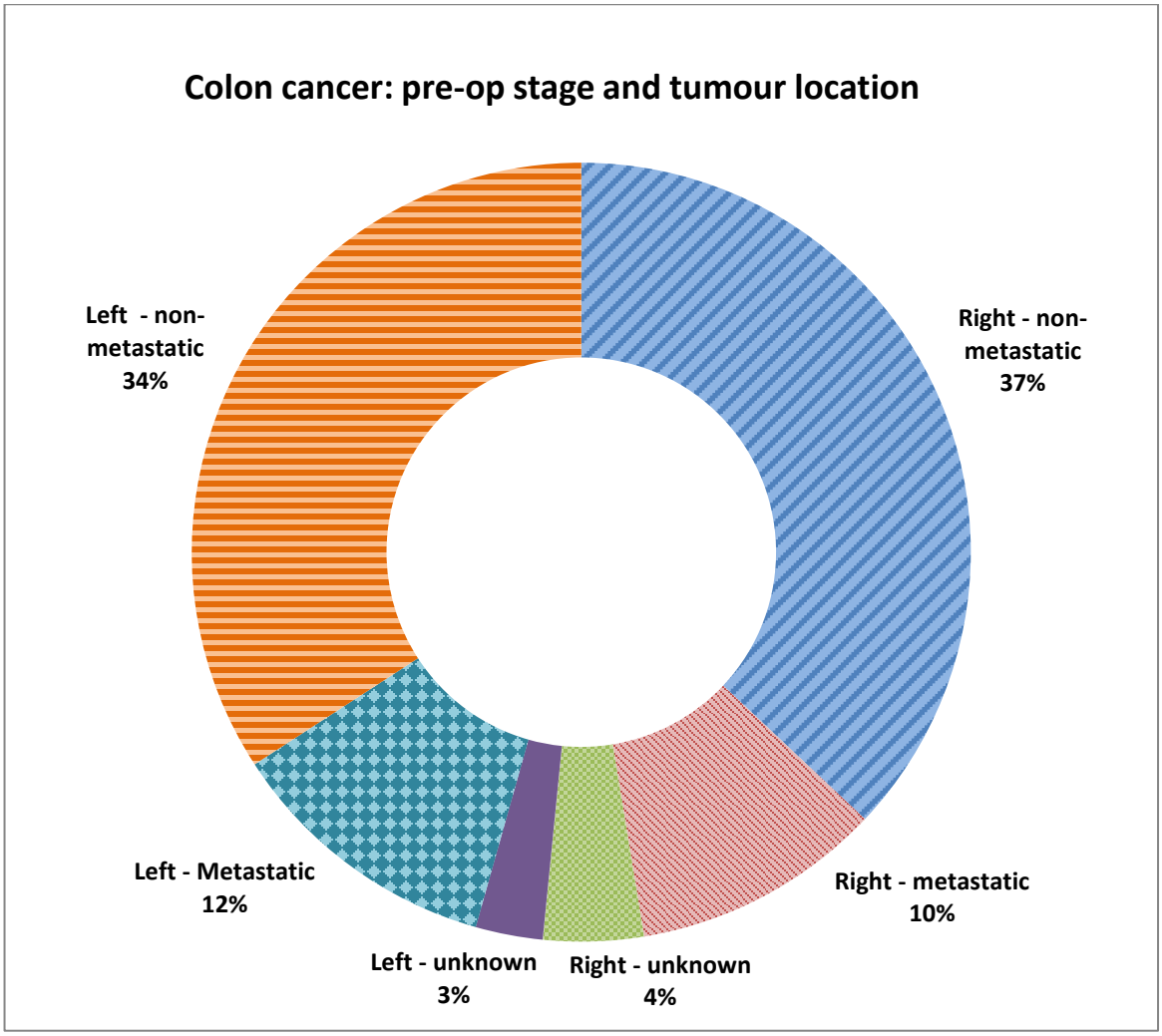

Figure 4.4-5 Doughnut plot of pre-op stage and tumour location for patients with colon cancer (excludes 44 patients where side of tumour was unknown).

4.4.2.2 Distance from health facility of diagnosis for colon cancer

The pattern of the association between stage at presentation and distance from health facility of diagnosis was not clear, although patients living 20-50 km from the health facility of diagnosis were slightly more likely to have metastatic disease at presentation (p=0.02) (Table 4.4-17). Further exploration of the relationships between rurality, distance, deprivation and ethnicity is needed to understand the patterns of care. The proportions of left-sided tumours did not appear to vary by distance (p=0.5) (Table 4.4-18).

Table 4.4-17 Pre-operative stage by distance to health facility of diagnosis at diagnosis for patients with colon cancer

	Distance from residence to facility of diagnosis (km)												
Pre-op stage	**0-<5**		**5-<10**		**10-<20**		**20-<50**		**50>/=**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Non-metastatic	911	70.3	565	74.0	378	66.4	428	70.6	279	70.6	2561	70.6	0.02
Metastatic	283	21.9	165	21.6	140	24.6	143	23.6	85	21.5	816	22.5	
Unknown	101	7.8	33	4.3	51	9.0	35	5.8	31	7.8	251	6.9	
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0	

Table 4.4-18 Tumour location by distance for residence to health facility of diagnosis for patients with colon cancer

	Distance from residence to facility of diagnosis (km)												
Tumour location	**0-<5**		**5-<10**		**10-<20**		**20-<50**		**50>/=**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Right	671	51.8	393	51.5	284	49.9	294	48.5	203	51.4	1845	50.9	0.5
Left	610	47.1	356	46.7	275	48.3	304	50.2	190	48.1	1735	47.8	
Unknown	14	1.1	14	1.8	10	1.8	8	1.3	2	0.5	48	1.3	
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0	

4.4.2.3 Area deprivation of residence at diagnosis for colon cancer

The proportions of patients presenting with stage IV disease were similar across the deprivation quintiles (p=0.6) (Table 4.4-19). There was a small increase in the proportion of patients with left sided tumours with increasing deprivation (p=0.05) (Table 4.4-20).

Table 4.4-19 Pre-operative stage by area deprivation score of residence at diagnosis for patients with colon cancer

Pre-op stage	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Non-metastatic	497	69.3	530	72.6	583	70.4	537	72.2	402	67.7	2549	70.6	0.6
Metastatic	169	23.6	156	21.4	192	23.2	155	20.8	143	24.1	815	22.6	
Unknown	51	7.1	44	6.0	53	6.4	52	7.0	49	8.2	249	6.9	
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0	

Table 4.4-20 Tumour sidedness by area deprivation score of residence at diagnosis for patients with colon cancer

Tumour location	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Right	378	52.7	374	51.2	441	53.3	359	48.3	283	47.6	1835	50.8	0.05
Left	331	46.2	342	46.8	380	45.9	379	50.9	298	50.2	1730	47.9	
Unknown	8	1.1	14	1.9	7	0.8	6	0.8	13	2.2	48	1.3	
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0	

4.4.2.4 Ethnicity for colon cancer

The proportion of patients who presented with metastatic colon cancer was slightly higher in Māori patients than in Pacific or nMnP patients (29% compared with 22% and 22%), but the difference was not statistically significant (p=0.3) (Table 4.4-21). However the difference in the proportion of left sided tumours was large (66% for Māori and 63% of Pacific patients compared with 47% for nMnP patients (p<0.0001) (Table 4.4-22).

Table 4.4-21 Pre-operative stage by ethnicity for patients with colon cancer

	Prioritised ethnicity								
Pre-op stage	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Non-metastatic	90	62.1	30	73.2	2473	70.4	2593	70.1	0.3
Metastatic	42	29.0	9	22.0	775	22.0	826	22.3	
Unknown	13	9.0	2	4.9	267	7.6	282	7.6	
Total	145	100.0	41	100.0	3515	100.0	3701	100.0	

Table 4.4-22 Tumour sidedness by ethnicity for patients with colon cancer

	Prioritised ethnicity								
Tumour location	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Right	46	31.7	14	34.1	1821	51.8	1881	50.8	<0.0001
Left	96	66.2	26	63.4	1647	46.9	1769	47.8	
Unknown	3	2.1	1	2.4	47	1.3	51	1.4	
Total	145	100.0	41	100.0	3515	100.0	3701	100.0	

4.4.3 Key points: demographic and clinical characteristics for colon cancer

Regarding age and gender:

- Rural patients appear to have a younger age distribution
- Māori and Pacific patients have greater proportions of colon cancer patients who are diagnosed at age 50 or younger.
- Pacific have a greater proportion of colon cancer patients who are males compared with Māori and nMnP.
- A higher proportion of colon cancer patients from rural areas are male. (This is also seen in those whose residence is further from the health facility where they were diagnosed– this appears more apparent for colon than rectum).

Regarding site of primary tumour:

- 51% of colon cancers are right sided and 48% left sided (1% unknown). Females are more likely to have a right sided colonic tumour (57%); males are more likely to have a left sided tumour (54%). 58% of right sided tumours occur in females and 55% of left sided tumours occur in males.
- Māori and Pacific patients have a greater proportion of colon cancer patients whose tumours are left-sided compared to nMnP (Māori: 66%, PI 63%, nMnP 47%). This unadjusted finding suggests a different distribution of primary tumour location, although some of the differences may be explained by differences in age and gender.

Regarding stage at presentation:

- Māori and Pacific have a greater proportion of colon cancer patients who have metastatic disease at the time of diagnosis compared to nMnP. Māori also have a higher proportion with an unknown stage at diagnosis compared to Pacific or nMnP.
- Of those patients presenting with metastatic disease, the primary tumour location is slightly more likely to be left-sided than right-sided (50 v 46%; 4% unknown). Given that Māori and Pacific are more likely to have left-sided tumours and more likely to present with metastatic disease this finding may represent differences by ethnicity and requires further analysis.
- There is no clear sign in the unadjusted analyses that distance to health facility of diagnosis is related to early vs. advanced stage at presentation.

Regarding deprivation and comorbidity:

- Rural patients diagnosed with colon or rectal cancers have less comorbidity (using the C3 score). This may reflect the younger rural population and will need to be age-adjusted to further understand this finding.
- Those in the most deprived socioeconomic groups have higher C3 comorbidity scores
- Those in the least deprived socioeconomic deprivation group appear to be slightly younger at diagnosis than those in the highest two deprivation groups; deciles 9-10 have the highest proportion of patients aged 80 years and over of all the deprivation groups. This role of ethnicity requires further exploration.
- Those in the most socioeconomically deprived group have the lowest proportion of non-metastatic cases, and are more likely to have unknown pre-operative stage
- There appears to be a slight inverse relationship between deprivation and sidedness, with those from the least deprived areas having more right-sided tumours and those most deprived having slightly more left-sided tumours. This may be related to ethnicity, as Māori have a higher proportion of left-sided cancers, so this finding will require further analysis to allow interpretation.

4.4.4 Discussion: demographic and clinical characteristics for colon cancer

This section describes the demographic and clinical characteristics of people diagnosed with colon cancer. We found that rural patients have a younger age at presentation, have less comorbidity, and a slightly higher proportion of left sided cancer. This may reflect the rural population as a whole. Presentation of age adjusted incidence figures by rurality, ethnicity and deprivation was outside the scope of this report, but we plan to address this in a future publication.

A right to left shift in colon cancer incidence in NZ has been described previously[34],as has the higher proportion of females with right sided tumours than males. Site of primary tumour is relevant to epidemiologists and policy makers when considering different screening methods for CRC.

Patterns of colorectal primary tumour and stage at presentation in Pacific patients have not previously been described.

Māori and Pacific have a higher proportion of cases that are diagnosed with metastatic disease than nMnP. This is also reflected in the higher proportion of cases presenting with obstruction, and through the ED. The reasons why Māori and Pacific have higher proportions presenting with metastatic disease are not understood, but this is outside the scope of the current project.

Previous work has demonstrated that socioeconomic deprivation is associated with slightly poorer cancer-specific and all-cause mortality following a diagnosis of CRC, and that patients with greater deprivation have more comorbidity.[35] Our project also demonstrates that those with greatest socioeconomic deprivation have higher comorbidity scores and also have the highest proportion of metastatic cases. Further work is planned to explore the relationship between deprivation, ethnicity, comorbidity, presentation and outcome.

4.5 Colon Cancer: Staging

4.5.1 Key performance indicators (KPIs) for staging for colon cancer

The key performance indicators used for describing the staging of colon cancer in this section are:

- Method of diagnosis
- Synoptic pathologic report
- Number of lymph nodes examined
- Staging with CT Abdomen/pelvis
- Completion of colonoscopy within one year
- Complete staging (CT abdomen/pelvis and complete colonoscopy)

Other measures of interest include:

- Differentiation of tumour
- Lymphatic or vascular (lymphovascular) invasion
- CT staging with CT chest

The NZ Guidelines Group (NZGG) recommendations on the management of early CRC provide an overview of standards of care in NZ. The Guideline recommends that pathology reports be structured (synoptic), that the entire colon be surveyed either pre-operatively or within 12 months of operation, and that staging assessment with a CT scan of the abdomen and pelvis be undertaken (the guideline recommends either chest X-ray or CT chest).[36]

Structured (synoptic) reporting has been recommended by the NZGG and others as these reports are considered more likely to contain all elements of information required for accurate prognostication. The definition of synoptic/structured report varies between guidelines. The definition used in the PIPER project is outlined in the methods section.

Both the Union for International Cancer Control(UICC) and the American Joint Committee on Cancer (AJCC) recommend that a minimum of 12 lymph nodes are evaluated to ensure that patients are adequately staged and that an accurate diagnosis of node negative or positive cancer is confirmed. If a patient has less than 12 nodes sampled, there is a genuine risk that they will be under staged, and that potentially appropriate adjuvant chemotherapy is not administered, which may result in a decrement in overall survival.

Patients with CRC are at increased risk of advanced polyps, and may also have a concurrent primary. Therefore colonoscopy to visualise the entire colon has been recommended pre-operatively, or up to 12 months post-operatively. The exceptions to this are the patient with right sided colon cancer, where the colon is visualised to the level of the tumour and the more proximal colon is resected, and the patient who undergoes complete colectomy or completion colectomy.

Whilst many guidelines mandate CT scanning of the chest, one retrospective review found that CT scanning detected pulmonary metastases in 6% of patients and indeterminate lesions in 8.6%.[37] Given the paucity of data the benefit from routine CT staging of the chest has been questioned.[38] The NZGG does not mandate CT staging of the chest.

4.5.2 Rurality of residence at diagnosis for colon cancer

Of the 3717 patients with colon cancer diagnosed in 2007 and 2008, 3634 had rurality of residence at diagnosis known.

For the majority of patients the pathological diagnosis of their colon cancer was made by colonoscopy (57%, 95%CI: 55 to 58) (Table 4.5-1). For 32% the method of initial diagnosis was made at surgery (95% CI: 30 to 33). The differences in method of initial diagnosis between urban/rural regions were small (53-58%) but statistically significant (p=0.01). For a small number of patients diagnosis was made by radiology only.

Table 4.5-1 Method by which the initial diagnosis of colon cancer was made by rurality of residence at the time of diagnosis

Initial diagnosis method	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value*
Colonoscopy	1498	57.9	344	52.7	217	55.1	2059	56.7	0.01
Surgery	776	30.0	237	36.3	137	34.8	1150	31.6	
CT	117	4.5	30	4.6	9	2.3	156	4.3	
Sigmoidoscopy	99	3.8	27	4.1	16	4.1	142	3.9	
Percutaneous biopsy	55	2.1	8	1.2	9	2.3	72	2.0	
CT Colonography	16	0.6	3	0.5	1	0.3	20	0.5	
Other	7	0.3	1	0.2	1	0.3	9	0.2	
Barium enema	5	0.2	1	0.2	1	0.3	7	0.2	
Ultrasound	5	0.2	0	0	0	0	5	0.1	
Laparoscopy	4	0.2	0	0	1	0.3	5	0.1	
Luminal biopsy unknown instrument	1	0.0	0	0	0	0	1	0.0	
X-ray	1	0.0	0	0	0	0	1	0.0	
MRI	1	0.0	0	0	0	0	1	0.0	
Clinical	1	0.0	0	0	0	0	1	0.0	
Unknown	1	0.0	2	0.3	2	0.5	5	0.1	
Total	2587	100.0	653	100.0	394	100.0	3634	100.0	

*p-value compares colonoscopy, surgery and the remaining methods grouped into an other category.

Of the 3717 patients diagnosed with colon cancer in 2007 and 2008, 3136 had resection of their primary tumour. Excluding those with the urban/rural classification of their residence at diagnosis unknown leaves 3061 patients for consideration of pathology measures.

Overall 56% of patients had a synoptic report (95% CI: 54 to 57) (Table 4.5-2). There was a difference by rurality of the patient's residence: 60% of those in urban areas had a synoptic report, compared with only 47% in independent urban areas and 46% in rural areas (p<0.0001). The overall proportion of patients with 12 or more lymph nodes removed was

65%, 95% CI: 63 to 66) (Table 4.5-3). In patients living in urban areas the proportion was 69%, compared with 54% for independent urban areas and 59% for rural areas (p<0.0001). There was no difference in the number of positive lymph nodes found by rurality of residence (p=0.5) (Table 4.5-4).

The overall proportion of colon cancer patients who had lymphovascular invasion was 29% (95% CI: 27 to 31) (Table 4.5-5). There was some difference in the proportions by rurality: for urban areas it was 31%, independent urban 24% and rural 23% (p<0.005). The proportion of poorly or undifferentiated tumours was 20% (95% CI: 19 to 22) (Table 4.5-6). The proportion was only slightly higher for rural regions (23%) than independent urban (20%) or urban (20%) but overall the differences in differentiation were statistically significant (p<0.0001).

Variation in the above surgical indicators is likely to reflect differences in clinical characteristics of the patients, such as stage of disease, and demographic characteristics, such as age. Further analysis of the reasons for observed differences in the crude proportions will be carried out in the second phase of our analysis.

Table 4.5-2 Synoptic pathology report from surgery for resection of primary by rurality of residence at diagnosis for patients with colon cancer

Synoptic pathology report	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	1282	59.6	263	46.8	160	46.0	1705	55.7	<0.0001
No	859	39.9	297	52.8	185	53.2	1341	43.8	
Unknown	10	0.5	2	0.4	3	0.9	15	0.5	
Total	2151	100.0	562	100.0	348	100.0	3061	100.0	

Table 4.5-3 Number of lymph nodes removed at surgery for resection of primary by rurality of residence at diagnosis for patients with colon cancer

No. lymph nodes examined	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
<12 nodes	655	30.5	247	44.0	139	39.9	1041	34.0	<0.0001
>=12 nodes	1473	68.5	303	53.9	205	58.9	1981	64.7	
Unknown	23	1.1	12	2.1	4	1.1	39	1.3	
Total	2151	100.0	562	100.0	348	100.0	3061	100.0	

Table 4.5-4 Number of positive lymph nodes by rurality of residence at diagnosis for patients with colon cancer

No. positive lymph nodes	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
0	1121	52.1	292	52.0	172	49.4	1585	51.8	0.5
1-3	525	24.4	142	25.3	101	29.0	768	25.1	
4-12	363	16.9	68	12.1	46	13.2	477	15.6	
>12	66	3.1	19	3.4	6	1.7	91	3.0	
Unknown	76	3.5	41	7.3	23	6.6	140	4.6	
Total	2151	100.0	562	100.0	348	100.0	3061	100.0	

Table 4.5-5 Lymphovascular invasion by rurality of residence at diagnosis for patients with rectal cancer for patients with colon cancer

Lymphovascular invasion	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	672	31.2	134	23.8	79	22.7	885	28.9	<0.005
No	1247	58.0	333	59.3	204	58.6	1784	58.3	
Unknown	232	10.8	95	16.9	65	18.7	392	12.8	
Total	2151	100.0	562	100.0	348	100.0	3061	100.0	

Table 4.5-6 Differentiation of the tumour cells by rurality of residence at diagnosis for patients with colon cancer

Differentiation	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Well	396	18.4	53	9.4	36	10.3	485	15.8	<0.0001
Moderate	1118	52.0	321	57.1	191	54.9	1630	53.3	
Poor	400	18.6	114	20.3	81	23.3	595	19.4	
Undifferentiated	28	1.3	0	0	1	0.3	29	0.9	
Unknown	209	9.7	74	13.2	39	11.2	322	10.5	
Total	2151	100.0	562	100.0	348	100.0	3061	100.0	

Colonoscopy and CT scans and are used to ensure detection of any second primary tumours or metastatic disease. For patients who presented acutely 67% had a CT scan of the abdomen and pelvis within an 8 week window around their date of surgery (95% CI: 65 to 70) (Table 4.5-7). For patients who did not present acutely 59% had a CT scan of the abdomen and pelvis within 8 weeks *before* surgery (95% CI: 57 to 61).

The proportion of patients who presented acutely who had CT scan of the chest within an 8 week window around their date of surgery was 33% (95% CI: 30 to 35) (Table 4.5-8). For patients who did not present acutely the proportion who had a CT scan of the chest within 8 weeks *before* surgery was 36% (95% CI: 34 to 38).

Table 4.5-7 CT scan of the abdomen and pelvis by rurality of residence at diagnosis for patients with colon cancer

CT of abdo/pelvis within 8 weeks		Rurality of residence at time of diagnosis							
		Urban		Independent urban		Rural			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdomen/pelvis**								
Yes	**Within 8 weeks before first treatment**	507	57.9	133	57.1	85	64.9	725	20.0
	Within 8 weeks after first treatment	78	8.9	20	8.6	13	9.9	111	3.1
	None within 8 weeks of first treatment	105	12.0	41	17.6	17	13.0	163	4.5
	Unknown or no treatment	186	21.2	39	16.7	16	12.2	241	6.6
	Total	876	100.0	233	100.0	131	100.0	1240	34.1
No	**CT of abdomen/pelvis**								
	Within 8 weeks before first treatment	935	59.1	228	57.3	158	63.5	1321	36.4
	Within 8 weeks after first treatment	156	9.9	35	8.8	29	11.6	220	6.1
	None within 8 weeks of first treatment	334	21.1	103	25.9	54	21.7	491	13.5
	Unknown or no treatment	158	10.0	32	8.0	8	3.2	198	5.4
	Total	1583	100.0	398	100.0	249	100.0	2230	61.4
Unknown	**CT of abdomen/pelvis**								
	Within 8 weeks before first treatment	60	46.9	13	59.1	8	57.1	81	2.2
	Within 8 weeks after first treatment	15	11.7	2	9.1	1	7.1	18	0.5
	None within 8 weeks of first treatment	46	35.9	5	22.7	3	21.4	54	1.5
	Unknown or no treatment	7	5.5	2	9.1	2	14.3	11	0.3
	Total	128	100.0	22	100.0	14	100.0	164	4.5
	Total	2587	100.0	653	100.0	394	100.0	3634	100.0

Table 4.5-8 CT scan of the chest by rurality of residence at diagnosis for patients with colon cancer

CT of chest within 8 weeks		Rurality of residence at time of diagnosis							
		Urban		Independent urban		Rural			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of chest**								
Yes	**Within 8 weeks before first treatment**	215	24.5	45	19.3	33	25.2	293	8.1
	Within 8 weeks after first treatment	75	8.6	22	9.4	14	10.7	111	3.1
	None within 8 weeks of first treatment	400	45.7	127	54.5	68	51.9	595	16.4
	Unknown or no treatment	186	21.2	39	16.7	16	12.2	241	6.6
	Total	876	100.0	233	100.0	131	100.0	1240	34.1
No	**CT of chest**								
	Within 8 weeks before first treatment	586	37.0	119	29.9	91	36.5	796	21.9
	Within 8 weeks after first treatment	106	6.7	25	6.3	21	8.4	152	4.2
	None within 8 weeks of first treatment	733	46.3	222	55.8	129	51.8	1084	29.8
	Unknown or no treatment	158	10.0	32	8.0	8	3.2	198	5.4
	Total	1583	100.0	398	100.0	249	100.0	2230	61.4
Unknown	**CT of chest**								
	Within 8 weeks before first treatment	51	39.8	6	27.3	6	42.9	63	1.7
	Within 8 weeks after first treatment	7	5.5	2	9.1	0	0	9	0.2
	None within 8 weeks of first treatment	63	49.2	12	54.5	6	42.9	81	2.2
	Unknown or no treatment	7	5.5	2	9.1	2	14.3	11	0.3
	Total	128	100.0	22	100.0	14	100.0	164	4.5
	Total	2587	100.0	653	100.0	394	100.0	3634	100.0

Of the 3717 patients diagnosed with colon cancer in 2007 and 2008, 2606 had non-metastatic disease and of these, 2465 had their primary resected. For 2423 of these the rurality of their residence at time of diagnosis was known. Of these, 2064 were known to be alive and progression free at 1 year. The proportion of these who had had a colonoscopy by 1 year was 61% (95% CI: 58 to 63). There was no difference by rurality of residence at diagnosis (p=0.1) (Table 4.5-10).

For patients with non-metastatic disease at presentation, complete staging was defined as having had a colonoscopy within 6 months before to 1 year after first treatment and a CT of the abdomen/pelvis within 8 weeks of first treatment. The proportion of the patients with non-metastatic disease who received some treatment for whom staging was complete was 41% (95% CI: 39 to 43) (Table 4.5-10).

For patients with metastatic disease at presentation, complete staging was defined as having a CT of the abdomen/pelvis and a CT of the chest within 8 weeks of the first treatment. The proportion of patients with metastatic disease who received some treatment for whom staging was complete was 47% (95% CI: 42 to 51) (Table 4.5-12).

Table 4.5-9 Disease outcomes by rurality of residence at diagnosis for patients with non-metastatic colon cancer who had their primary disease resected

Alive and disease free at 1 year	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
No treatment date*	8	0.5	1	0.2	0	0	9	0.4	0.6
Sill alive and progression free	1002	59.4	271	59.3	172	61.9	1445	59.6	
Progressed or died within a year	252	14.9	67	14.7	31	11.2	350	14.4	
Progressed or died after 1yr	426	25.2	118	25.8	75	27.0	619	25.5	
Total	1688	100.0	457	100.0	278	100.0	2423	100.0	

*Date of first treatment is unknown

Table 4.5-10 Colonoscopy within 1 year of initial treatment for patients with non-metastatic colon cancer patients who were still alive and progression free at 1 year by rurality of residence at diagnosis.

Colonoscopy within 1 year	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	883	61.8	219	56.3	147	59.5	1249	60.5	0.1
No	545	38.2	170	43.7	100	40.5	815	39.5	
Total	1428	100.0	389	100.0	247	100.0	2064	100.0	

Table 4.5-11 Completeness of staging by rurality of residence at diagnosis for patients with non-metastatic colon cancer who were alive and disease free at 1 year

Completeness of staging	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	594	41.6	147	37.8	103	41.7	844	40.9	0.4
No	834	58.4	242	62.2	144	58.3	1220	59.1	
Total	1428	100.0	389	100.0	247	100.0	2064	100.0	

Table 4.5-12 Completeness of staging by rurality of residence at diagnosis for patients with metastatic colon cancer who were alive and disease free at 1 year

Completeness of staging	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	185	49.3	32	33.0	38	50.7	255	46.6	0.01
No	190	50.7	65	67.0	37	49.3	292	53.4	
Total	375	100.0	97	100.0	75	100.0	547	100.0	

4.5.3 Distance of residence at diagnosis from the health facility of diagnosis for colon cancer

Of the 3717 patients with colon cancer diagnosed in 2007 and 2008, the distance of their residence from the health facility where they were diagnosed was known for 3628.

The proportion of patients diagnosed by colonoscopy did not vary by distance of residence from the diagnostic facility (p=0.3) (Table 4.5-13).

Of the 981 patients who had had their tumour resected, the distance from their residence to the diagnostic facility was known for 951. The proportion of patients who had a synoptic pathology report from the resection was higher for those living 5-10m from the diagnostic facility (63% compared with 50-50% at distances nearer to or further from the diagnostic facility(Table 4.5-14). There was no statistically significant difference in the number of lymph nodes removed or the number of positive lymph nodes found by distance of residence from the diagnostic facility (p=0.05 and 0.7 respectively) (Table 4.5-15, Table 4.5-16).

The proportion of patients with lymphovascular space invasion was greater among those living 5-10km from the diagnostic facility (35% vs. 22-29% elsewhere, p=0.0003)(Table 4.5-17). There were slightly higher proportions of patients with well differentiated tumour living 5-10 and 10-20km from the diagnostic facility (23% for both compared with 8-13% elsewhere, p<0.0001) (Table 4.5-18).

The proportions of patients who had a CT scan of the abdomen and pelvis are presented separately for those who presented acutely vs. not acutely. However there was little difference among the two groups or by distance of residence from the diagnostic facility. Patients who lived over 50km from the diagnostic facility, or within 0-5km had the lowest proportion who had had a CT of the chest (Table 4.5-19, Table 4.5-20).

There were 2465 patients with non-metastatic colon cancer who had their primary resected, and the distance of their residence from the diagnostic facility was known for 2421.The colonoscopy and completeness of staging variables are calculated on the group of patients who are alive and disease free at 1 year. Patients living close to the diagnostic facility or over 50km away had the lowest proportion who had had a colonoscopy within 1 year after first treatment (p=0.04) (Table 4.5-22). There were no statistically significant differences in the proportions with complete staging by distance (p=0.4 for non-metastatic disease and p=0.3 for metastatic disease) (Table 4.5-23, Table 4.5-24).

Table 4.5-13 Method by which the initial diagnosis of colon cancer was made by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

Initial diagnosis method	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	727	56.1	448	58.7	322	56.6	337	55.6	222	56.2	2056	56.7	0.3
Surgery	409	31.6	221	29.0	183	32.2	195	32.2	140	35.4	1148	31.6	
CT	57	4.4	37	4.8	29	5.1	22	3.6	11	2.8	156	4.3	
Sigmoidoscopy	52	4.0	27	3.5	22	3.9	28	4.6	12	3.0	141	3.9	
Percutaneous biopsy	25	1.9	19	2.5	7	1.2	15	2.5	6	1.5	72	2.0	
CT Colonography	12	0.9	4	0.5	2	0.4	2	0.3	0	0	20	0.5	
Other	3	0.2	3	0.4	1	0.2	1	0.2	1	0.3	9	0.2	
Barium enema	3	0.2	0	0	1	0.2	2	0.3	1	0.3	7	0.2	
Ultrasound	3	0.2	0	0	1	0.2	1	0.2	0	0	5	0.1	
Laparoscopy	2	0.2	2	0.3	0	0	1	0.2	0	0	5	0.1	
Luminal biopsy unknown instrument	0	0	1	0.1	0	0	0	0	0	0	1	0.0	
X-ray	0	0	1	0.1	0	0	0	0	0	0	1	0.0	
MRI	1	0.1	0	0	0	0	0	0	0	0	1	0.0	
Clinical	0	0	0	0	0	0	1	0.2	0	0	1	0.0	
Unknown	1	0.1	0	0	1	0.2	1	0.2	2	0.5	5	0.1	
Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0	

Table 4.5-14 Synoptic pathology report from surgery for resection of colon cancer primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made.

Synoptic pathology report	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	589	54.0	388	62.9	277	57.7	276	52.8	174	50.3	1704	55.8	0.0002
No	497	45.6	224	36.3	202	42.1	244	46.7	170	49.1	1337	43.8	
Unknown	4	0.4	5	0.8	1	0.2	3	0.6	2	0.6	15	0.5	
Total	1090	100.0	617	100.0	480	100.0	523	100.0	346	100.0	3056	100.0	

Table 4.5-15 Number of lymph nodes examined at surgery for resection of colon cancer primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

No. lymph nodes examined	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
<12 nodes	371	34.0	187	30.3	155	32.3	191	36.5	133	38.4	1037	33.9	0.05
>=12 nodes	705	64.7	423	68.6	320	66.7	324	62.0	208	60.1	1980	64.8	
Unknown	14	1.3	7	1.1	5	1.0	8	1.5	5	1.4	39	1.3	
Total	1090	100.0	617	100.0	480	100.0	523	100.0	346	100.0	3056	100.0	

Table 4.5-16 Number of positive lymph nodes by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with colon cancer

No. positive lymph nodes	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
0	563	51.7	328	53.2	251	52.3	261	49.9	180	52.0	1583	51.8	0.7
1-3	262	24.0	148	24.0	122	25.4	148	28.3	87	25.1	767	25.1	
4-12	179	16.4	104	16.9	77	16.0	65	12.4	50	14.5	475	15.5	
>12	34	3.1	17	2.8	14	2.9	17	3.3	9	2.6	91	3.0	
Unknown	52	4.8	20	3.2	16	3.3	32	6.1	20	5.8	140	4.6	
Total	1090	100.0	617	100.0	480	100.0	523	100.0	346	100.0	3056	100.0	

Table 4.5-17 Lymphovascular space invasion by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with colon cancer

Lymphovascular invasion	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	307	28.2	217	35.2	132	27.5	151	28.9	77	22.3	884	28.9	0.0003
No	628	57.6	326	52.8	291	60.6	305	58.3	231	66.8	1781	58.3	
Unknown	155	14.2	74	12.0	57	11.9	67	12.8	38	11.0	391	12.8	
Total	1090	100.0	617	100.0	480	100.0	523	100.0	346	100.0	3056	100.0	

Table 4.5-18 Differentiation of the tumour by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with colon cancer

Differentiation	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Well	145	13.3	140	22.7	111	23.1	60	11.5	27	7.8	483	15.8	<.0001
Moderate	590	54.1	257	41.7	250	52.1	312	59.7	218	63.0	1627	53.2	
Poor	203	18.6	129	20.9	90	18.8	102	19.5	71	20.5	595	19.5	
Undifferentiated	12	1.1	7	1.1	6	1.3	4	0.8	0	0	29	0.9	
Unknown	140	12.8	84	13.6	23	4.8	45	8.6	30	8.7	322	10.5	
Total	1090	100.0	617	100.0	480	100.0	523	100.0	346	100.0	3056	100.0	

Table 4.5-19 CT scan of the abdomen and pelvis by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with colon cancer

CT abdomen/pelvis within 8 weeks		Distance from residence to facility of diagnosis (km)											
		0-<5		5-<10		10-<20		20-<50		50-<100			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdomen/pelvis**												
Yes	**Within 8 weeks before first treatment**	263	58.3	152	59.6	108	58.4	120	56.1	81	60.4	724	20.0
	Within 8 weeks after first treatment	38	8.4	19	7.5	16	8.6	21	9.8	17	12.7	111	3.1
	None within 8 weeks of first treatment	59	13.1	25	9.8	25	13.5	35	16.4	19	14.2	163	4.5
	Unknown or no treatment	91	20.2	59	23.1	36	19.5	38	17.8	17	12.7	241	6.6
	Total	451	100.0	255	100.0	185	100.0	214	100.0	134	100.0	1239	34.2
No	**CT of abdomen/pelvis**												
	Within 8 weeks before first treatment	458	58.0	287	60.3	202	58.2	232	62.9	142	57.5	1321	36.4
	Within 8 weeks after first treatment	69	8.7	43	9.0	43	12.4	47	12.7	18	7.3	220	6.1
	None within 8 weeks of first treatment	187	23.7	91	19.1	74	21.3	62	16.8	76	30.8	490	13.5
	Unknown or no treatment	76	9.6	55	11.6	28	8.1	28	7.6	11	4.5	198	5.5
	Total	790	100.0	476	100.0	347	100.0	369	100.0	247	100.0	2229	61.4
Unknown	**CT of abdomen/pelvis**												
	Within 8 weeks before first treatment	27	50.0	16	50.0	20	54.1	10	43.5	6	42.9	79	2.2
	Within 8 weeks after first treatment	5	9.3	2	6.3	7	18.9	3	13.0	1	7.1	18	0.5
	None within 8 weeks of first treatment	19	35.2	11	34.4	7	18.9	9	39.1	7	50.0	53	1.5
	Unknown or no treatment	3	5.6	3	9.4	3	8.1	1	4.3	0	0	10	0.3
	Total	54	100.0	32	100.0	37	100.0	23	100.0	14	100.0	160	4.4
	Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0

Table 4.5-20 CT scan of the chest by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with colon cancer

CT chest within 8 weeks		Distance from residence to facility of diagnosis (km)											
		0-<5		5-<10		10-<20		20-<50		50-<100			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT of chest**												
Yes	**Within 8 weeks before first treatment**	100	22.2	73	28.6	44	23.8	52	24.3	24	17.9	293	8.1
	Within 8 weeks after first treatment	36	8.0	16	6.3	21	11.4	19	8.9	19	14.2	111	3.1
	None within 8 weeks of first treatment	224	49.7	107	42.0	84	45.4	105	49.1	74	55.2	594	16.4
	Unknown or no treatment	91	20.2	59	23.1	36	19.5	38	17.8	17	12.7	241	6.6
	Total	451	100.0	255	100.0	185	100.0	214	100.0	134	100.0	1239	34.2
No	**CT of chest**												
	Within 8 weeks before first treatment	254	32.2	176	37.0	137	39.5	149	40.4	80	32.4	796	21.9
	Within 8 weeks after first treatment	49	6.2	29	6.1	33	9.5	29	7.9	12	4.9	152	4.2
	None within 8 weeks of first treatment	411	52.0	216	45.4	149	42.9	163	44.2	144	58.3	1083	29.9
	Unknown or no treatment	76	9.6	55	11.6	28	8.1	28	7.6	11	4.5	198	5.5
	Total	790	100.0	476	100.0	347	100.0	369	100.0	247	100.0	2229	61.4
Unknown	**CT of chest**												
	Within 8 weeks before first treatment	18	33.3	14	43.8	18	48.6	8	34.8	5	35.7	63	1.7
	Within 8 weeks after first treatment	2	3.7	1	3.1	3	8.1	3	13.0	0	0	9	0.2
	None within 8 weeks of first treatment	31	57.4	14	43.8	13	35.1	11	47.8	9	64.3	78	2.1
	Unknown or no treatment	3	5.6	3	9.4	3	8.1	1	4.3	0	0	10	0.3
	Total	54	100.0	32	100.0	37	100.0	23	100.0	14	100.0	160	4.4
	Total	1295	100.0	763	100.0	569	100.0	606	100.0	395	100.0	3628	100.0

Table 4.5-21 Disease outcomes by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer who had their primary resected

Alive and disease free at 1 year	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
No treatment date*	4	0.5	2	0.4	1	0.3	0	0	2	0.7	9	0.4	0.8
Sill alive and progression free	505	58.7	307	59.8	210	59.2	256	61.5	165	59.8	1443	59.6	
Progressed or died within a year	128	14.9	83	16.2	51	14.4	54	13.0	34	12.3	350	14.5	
Progressed or died after 1yr	224	26.0	121	23.6	93	26.2	106	25.5	75	27.2	619	25.6	
Total	861	100.0	513	100.0	355	100.0	416	100.0	276	100.0	2421	100.0	

*Date of first treatment is unknown

Table 4.5-22 Colonoscopy within 1 year of initial treatment for patients with non-metastatic colon cancer who had their primary resected who were still alive and progression free at 1 year by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

Colonoscopy within 1 year	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	421	57.8	284	66.4	179	59.1	225	62.2	139	57.9	1248	60.5	0.04
No	308	42.2	144	33.6	124	40.9	137	37.8	101	42.1	814	39.5	
Total	729	100.0	428	100.0	303	100.0	362	100.0	240	100.0	2062	100.0	

Table 4.5-23 Completeness of staging at diagnosis for patients with non-metastatic colon cancer who were alive and disease free at 1 year by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

Completeness of staging	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	293	40.2	185	43.2	117	38.6	159	43.9	90	37.5	844	40.9	0.4
No	436	59.8	243	56.8	186	61.4	203	56.1	150	62.5	1218	59.1	
Total	729	100.0	428	100.0	303	100.0	362	100.0	240	100.0	2062	100.0	

Table 4.5-24 Completeness of staging at diagnosis for patients with metastatic colon cancer who were alive and disease free at 1 year by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

Completeness of staging	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	75	41.7	53	53.0	49	47.6	42	44.7	36	53.7	255	46.9	0.3
No	105	58.3	47	47.0	54	52.4	52	55.3	31	46.3	289	53.1	
Total	180	100.0	100	100.0	103	100.0	94	100.0	67	100.0	544	100.0	

4.5.4 Area deprivation of residence at diagnosis for colon cancer

Of the 3717 patients with colon cancer diagnosed in 2007 and 2008, the NZ Deprivation Index score for their residence at the time of diagnosis was known for 3628. The proportion who had their colon cancer initially diagnosed by colonoscopy was 59% of those living in the least deprived areas (1-2), and decreased across the higher deprivation areas to 50% (p=0.01) (Table 4.5-25).

There was little difference in the proportion with a synoptic pathology report (p=0.2), the number of lymph nodes examined (p=0.4) or the number of positive lymph nodes (p=0.9) by degree of deprivation (Table 4.5-26, Table 4.5-27, Table 4.5-28). There was also little difference in the proportion with lymphovascular invasion (p=0.3) or the differentiation of the tumour (p=0.6) (Table 4.5-29, Table 4.5-30).

For patients presenting acutely, those living in areas of least deprivation (1-2) had a slightly higher proportion who had a CT scan of the abdomen and pelvis (62%) compared to those in areas of higher deprivation (9-10: 56%). There was no difference in the proportion having a CT scan of the abdomen and pelvis by level of deprivation for those not presenting acutely (Table 4.5-31)

There was a similar decrease in the proportion of patients who presented acutely who had a CT scan of the chest (29% in the lowest quintile of deprivation (1-2) and 20% in the highest (9-10). For patients presenting non-acutely there was no difference in proportion having a CT of the chest in the different quintiles of deprivation (Table 4.5-32).

Of the 2465 patients with non-metastatic colon cancer who had their primary resected, the area deprivation of their residence at diagnosis was known for 2410.

Colonoscopy by 1 year did not vary by deprivation of the area of residence at diagnosis (p=0.8) (Table 4.5-34). There was also no variation in completeness of staging for stage patients with non-metastatic disease or patients with metastatic disease by deprivation (p=0.98 and p=0.5 respectively) (Table 4.5-35, Table 4.5-36).

Table 4.5-25 Method by which the initial diagnosis of colon cancer was made by area deprivation score for residence at the time of diagnosis

Initial diagnosis method	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	423	59.0	424	58.1	487	58.8	414	55.6	299	50.3	2047	56.7	0.01
Surgery	225	31.4	223	30.5	258	31.2	234	31.5	206	34.7	1146	31.7	
CT	22	3.1	29	4.0	31	3.7	36	4.8	35	5.9	153	4.2	
Sigmoidoscopy	22	3.1	23	3.2	28	3.4	35	4.7	33	5.6	141	3.9	
Percutaneous biopsy	11	1.5	19	2.6	16	1.9	11	1.5	15	2.5	72	2.0	
CT Colonography	7	0.9	6	0.8	3	0.4	1	0.1	2	0.3	19	0.5	
Other	2	0.3	2	0.3	0	0	2	0.3	3	0.5	9	0.2	
Barium enema	1	0.1	0	0	2	0.2	4	0.5	0	0	7	0.2	
Ultrasound	1	0.1	3	0.4	1	0.1	0	0	0	0	5	0.1	
Laparoscopy	2	0.3	0	0	0	0	3	0.4	0	0	5	0.1	
Luminal biopsy unknown instrument	0	0	0	0	0	0	1	0.1	0	0	1	0.0	
X-ray	0	0	1	0.1	0	0	0	0	0	0	1	0.0	
MRI	0	0	0	0	0	0	1	0.1	0	0	1	0.0	
Clinical	0	0	0	0	0	0	1	0.1	0	0	1	0.0	
Unknown	1	0.1	0	0	2	0.2	1	0.1	1	0.2	5	0.1	
Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0	

Table 4.5-26 Synoptic pathology report from surgery for resection of colon cancer primary by area deprivation score for residence at the time of diagnosis

Synoptic pathology report	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	355	57.4	353	57.7	394	56.2	350	55.1	245	51.3	1697	55.7	0.2
No	259	41.9	256	41.8	303	43.2	284	44.7	230	48.1	1332	43.8	
Unknown	4	0.6	3	0.5	4	0.6	1	0.2	3	0.6	15	0.5	
Total	618	100.0	612	100.0	701	100.0	635	100.0	478	100.0	3044	100.0	

Table 4.5-27 Number of lymph nodes examined at surgery for resection of colon cancer primary by area deprivation score for residence at the time of diagnosis

No. lymph nodes examined	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
<12 nodes	204	33.0	189	30.9	248	35.4	223	35.1	171	35.8	1035	34.0	0.4
>=12 nodes	405	65.5	414	67.6	449	64.1	404	63.6	299	62.6	1971	64.8	
Unknown	9	1.5	9	1.5	4	0.6	8	1.3	8	1.7	38	1.2	
Total	618	100.0	612	100.0	701	100.0	635	100.0	478	100.0	3044	100.0	

Table 4.5-28 Number of positive lymph nodes by area deprivation score for residence at the time of diagnosis for patients with colon cancer

No. positive lymph nodes	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
0	316	51.1	303	49.5	372	53.1	338	53.2	247	51.7	1576	51.8	0.9
1-3	158	25.6	160	26.1	175	25.0	160	25.2	108	22.6	761	25.0	
4-12	103	16.7	93	15.2	113	16.1	90	14.2	78	16.3	477	15.7	
>12	16	2.6	20	3.3	17	2.4	20	3.1	18	3.8	91	3.0	
Unknown	25	4.0	36	5.9	24	3.4	27	4.3	27	5.6	139	4.6	
Total	618	100.0	612	100.0	701	100.0	635	100.0	478	100.0	3044	100.0	

Table 4.5-29 Lymphovascular space invasion by area deprivation score for residence at the time of diagnosis for patients with colon cancer

Lymphovascular invasion	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	188	30.4	187	30.6	182	26.0	186	29.3	137	28.7	880	28.9	0.3
No	347	56.1	346	56.5	424	60.5	374	58.9	284	59.4	1775	58.3	
Unknown	83	13.4	79	12.9	95	13.6	75	11.8	57	11.9	389	12.8	
Total	618	100.0	612	100.0	701	100.0	635	100.0	478	100.0	3044	100.0	

Table 4.5-30 Differentiation of the tumour by area deprivation score for residence at the time of diagnosis for patients with colon cancer

Differentiation	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Well	95	15.4	102	16.7	118	16.8	98	15.4	69	14.4	482	15.8	0.6
Moderate	317	51.3	318	52.0	365	52.1	337	53.1	282	59.0	1619	53.2	
Poor	132	21.4	113	18.5	130	18.5	135	21.3	84	17.6	594	19.5	
Undifferentiated	8	1.3	7	1.1	5	0.7	5	0.8	3	0.6	28	0.9	
Unknown	66	10.7	72	11.8	83	11.8	60	9.4	40	8.4	321	10.5	
Total	618	100.0	612	100.0	701	100.0	635	100.0	478	100.0	3044	100.0	

Table 4.5-31 CT scan of the abdomen and pelvis by area deprivation score for residence at the time of diagnosis for patients with colon cancer

CT abdomen/pelvis within 8 weeks		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdomen/pelvis**												
Yes	**Within 8 weeks before first treatment**	129	61.4	140	61.1	168	60.4	143	56.1	141	54.7	721	20.0
	Within 8 weeks after first treatment	22	10.5	14	6.1	26	9.4	23	9.0	24	9.3	109	3.0
	None within 8 weeks of first treatment	28	13.3	24	10.5	33	11.9	38	14.9	39	15.1	162	4.5
	Unknown or no treatment	31	14.8	51	22.3	51	18.3	51	20.0	54	20.9	238	6.6
	Total	210	100.0	229	100.0	278	100.0	255	100.0	258	100.0	1230	34.0
No	**CT of abdomen/pelvis**												
	Within 8 weeks before first treatment	285	61.8	273	59.6	308	59.5	273	58.6	178	56.2	1317	36.5
	Within 8 weeks after first treatment	42	9.1	50	10.9	49	9.5	49	10.5	30	9.5	220	6.1
	None within 8 weeks of first treatment	102	22.1	95	20.7	121	23.4	102	21.9	66	20.8	486	13.5
	Unknown or no treatment	32	6.9	40	8.7	40	7.7	42	9.0	43	13.6	197	5.5
	Total	461	100.0	458	100.0	518	100.0	466	100.0	317	100.0	2220	61.4
Unknown	**CT of abdomen/pelvis**												
	Within 8 weeks before first treatment	19	41.3	25	58.1	15	46.9	11	47.8	11	57.9	81	2.2
	Within 8 weeks after first treatment	4	8.7	4	9.3	4	12.5	4	17.4	2	10.5	18	0.5
	None within 8 weeks of first treatment	18	39.1	11	25.6	12	37.5	6	26.1	6	31.6	53	1.5
	Unknown or no treatment	5	10.9	3	7.0	1	3.1	2	8.7	0	0	11	0.3
	Total	46	100.0	43	100.0	32	100.0	23	100.0	19	100.0	163	4.5
	Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0

Table 4.5-32 CT scan of the chest by area deprivation score for residence at the time of diagnosis for patients with colon cancer

CT chest within 8 weeks		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT of chest**												
Yes	**Within 8 weeks before first treatment**	60	28.6	49	21.4	67	24.1	60	23.5	52	20.2	288	8.0
	Within 8 weeks after first treatment	25	11.9	20	8.7	23	8.3	18	7.1	24	9.3	110	3.0
	None within 8 weeks of first treatment	94	44.8	109	47.6	137	49.3	126	49.4	128	49.6	594	16.4
	Unknown or no treatment	31	14.8	51	22.3	51	18.3	51	20.0	54	20.9	238	6.6
	Total	210	100.0	229	100.0	278	100.0	255	100.0	258	100.0	1230	34.0
No	**CT of chest**												
	Within 8 weeks before first treatment	167	36.2	176	38.4	189	36.5	156	33.5	105	33.1	793	21.9
	Within 8 weeks after first treatment	34	7.4	35	7.6	24	4.6	29	6.2	30	9.5	152	4.2
	None within 8 weeks of first treatment	228	49.5	207	45.2	265	51.2	239	51.3	139	43.8	1078	29.8
	Unknown or no treatment	32	6.9	40	8.7	40	7.7	42	9.0	43	13.6	197	5.5
	Total	461	100.0	458	100.0	518	100.0	466	100.0	317	100.0	2220	61.4
Unknown	**CT of chest**												
	Within 8 weeks before first treatment	14	30.4	18	41.9	14	43.8	6	26.1	11	57.9	63	1.7
	Within 8 weeks after first treatment	3	6.5	3	7.0	1	3.1	1	4.3	1	5.3	9	0.2
	None within 8 weeks of first treatment	24	52.2	19	44.2	16	50.0	14	60.9	7	36.8	80	2.2
	Unknown or no treatment	5	10.9	3	7.0	1	3.1	2	8.7	0	0	11	0.3
	Total	46	100.0	43	100.0	32	100.0	23	100.0	19	100.0	163	4.5
	Total	717	100.0	730	100.0	828	100.0	744	100.0	594	100.0	3613	100.0

Table 4.5-33 Disease outcomes for patients with non-metastatic colon cancer whose primary was resected by distance of residence at the time of diagnosis by area deprivation score for residence at the time of diagnosis

Alive and disease free at 1 year	Deprivation index 2006											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
No treatment date*	5	1.1	3	0.6	0	0	1	0.2	0	0	9	0.4
Still alive and progression free	304	64.0	311	62.4	330	59.0	300	58.9	194	52.6	1439	59.7
Progressed or died within a year	59	12.4	64	12.9	80	14.3	71	13.9	73	19.8	347	14.4
Progressed or died after 1yr	107	22.5	120	24.1	149	26.7	137	26.9	102	27.6	615	25.5
Total	475	100.0	498	100.0	559	100.0	509	100.0	369	100.0	2410	100.0

*Date of first treatment is unknown

Table 4.5-34 Colonoscopy within 1 year of initial treatment for patients with non-metastatic colon cancer whose primary was resected, who were still alive and progression free at 1 year by area deprivation score for residence at the time of diagnosis

Colonoscopy within 1 year	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	255	62.0	255	59.2	296	61.8	257	58.8	181	61.1	1244	60.6	0.8
No	156	38.0	176	40.8	183	38.2	180	41.2	115	38.9	810	39.4	
Total	411	100.0	431	100.0	479	100.0	437	100.0	296	100.0	2054	100.0	

Table 4.5-35 Completeness of staging at diagnosis for patients with non-metastatic colon cancer who were alive and disease free at 1 year by area deprivation score for residence at the time of diagnosis

Completeness of staging	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	172	41.8	174	40.4	193	40.3	178	40.7	124	41.9	841	40.9	0.98
No	239	58.2	257	59.6	286	59.7	259	59.3	172	58.1	1213	59.1	
Total	411	100.0	431	100.0	479	100.0	437	100.0	296	100.0	2054	100.0	

Table 4.5-36 Completeness of staging at diagnosis for patients with metastatic colon cancer who were alive and disease free at 1 year by area deprivation score for residence at the time of diagnosis

Completeness of staging	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	67	51.5	49	50.0	55	41.7	44	45.4	38	43.2	253	46.4	0.5
5No	63	48.5	49	50.0	77	58.3	53	54.6	50	56.8	292	53.6	
Total	130	100.0	98	100.0	132	100.0	97	100.0	88	100.0	545	100.0	

4.5.5 Ethnicity for colon cancer

There were 4193 patients in the extended PIPER cohort diagnosed with colon cancer in the years 2006-2009. Ethnicity was known for 4163 of these.

The proportions of patients whose initial diagnosis was made by colonoscopy were very similar: 51% for Māori, 55% for Pacific and 57% for nMnP (p=0.1) (Table 4.5-37).

Of the 4193 patients 3497 had surgery for resection of their primary tumour. The proportion of Māori patients with a synoptic pathology report was 45%, whereas for Pacific patients it was 80% and for nMnP 55% (p<0.0001) (Table 4.5-38). The group of Māori patients also had fewer lymph nodes examined (57%) compared with 85% for Pacific patients and 65% for nMnP patients (p=0.0002) (Table 4.5-39). The proportion of patients with one or more positive nodes also differed by ethnicity (p=0.0003), although the comparison is not reliable as the groups had different numbers of nodes examined (Table 4.5-40). The Pacific patient group had a higher proportion with lymphovascular space invasion (43% vs. 33% for Māori and 29% for nMnP, p=0.04) (Table 4.5-41). The proportions of the patients whose tumours were poorly differentiated was 15% for Māori, 17% for Pacific and 20% for nMnP patients (p=0.0009) (Table 4.5-42).

The proportions of Māori and Pacific patients who presented acutely who had CT scans of the abdomen and pelvis within an 8 week window around the date of surgery were 73% and 70% respectively. The proportion was slightly lower for nMnP (67%) (Table 4.5-43). For patients presenting non-acutely the proportions who had a CT scan of the abdomen and pelvis within 8 weeks before surgery were Māori 55%, Pacific 63% and nMnP 59%. The proportions of those presenting acutely who had a chest CT within the 8 week window were very similar in Māori, Pacific and nMnP, but among those who did not present acutely the Pacific patient group had a higher proportion with a chest CT (50%) compared with Māori (35%) and nMnP (36%) (Table 4.5-43).

The proportions with a colonoscopy by one year, similar in the Māori, Pacific and nMnP groups (p=0.5) as were the proportions with complete staging (p=0.8 for non-metastatic and p=0.95 for metastatic) (Table 4.5-46, Table 4.5-47, Table 4.5-48).

Table 4.5-37 Method by which the initial diagnosis of colon cancer was made by prioritised ethnicity

Initial diagnosis method	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	157	50.8	46	54.8	2131	56.5	2334	56.1	0.1
Surgery	110	35.6	23	27.4	1192	31.6	1325	31.8	
CT	10	3.2	4	4.8	161	4.3	175	4.2	
Sigmoidoscopy	19	6.1	8	9.5	138	3.7	165	4.0	
Percutaneous biopsy	10	3.2	3	3.6	70	1.9	83	2.0	
CT Colonography	0	0	0	0	20	0.5	20	0.5	
Other	0	0	0	0	10	0.3	10	0.2	
Barium enema	1	0.3	0	0	7	0.2	8	0.2	
Ultrasound	1	0.3	0	0	8	0.2	9	0.2	
Laparoscopy	0	0	0	0	5	0.1	5	0.1	
Luminal biopsy unknown instrument	0	0	0	0	11	0.3	11	0.3	
X-ray	0	0	0	0	2	0.1	2	0.0	
MRI	0	0	0	0	1	0.0	1	0.0	
Clinical	0	0	0	0	1	0.0	1	0.0	
Unknown	1	0.3	0	0	13	0.3	14	0.3	
Total	309	100.0	84	100.0	3770	100.0	4163	100.0	

Table 4.5-38 Synoptic pathology report from surgery for resection of colon cancer primary by prioritised ethnicity

Synoptic pathology report	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	115	45.1	52	80.0	1734	54.6	1901	54.4	<.0001
No	136	53.3	13	20.0	1421	44.7	1570	44.9	
Unknown	4	1.6	0	0	22	0.7	26	0.7	
Total	255	100.0	65	100.0	3177	100.0	3497	100.0	

Table 4.5-39 Number of lymph nodes examined at surgery for resection of colon cancer primary by prioritised ethnicity

No. lymph nodes examined	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
<12 nodes	106	41.6	10	15.4	1083	34.1	1199	34.3	0.0002
>=12 nodes	146	57.3	55	84.6	2055	64.7	2256	64.5	
Unknown	3	1.2	0	0	39	1.2	42	1.2	
Total	255	100.0	65	100.0	3177	100.0	3497	100.0	

Table 4.5-40 Number of positive lymph nodes by prioritised ethnicity for patients with colon cancer.

No. positive lymph nodes	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
0	113	44.3	25	38.5	1672	52.6	1810	51.8	0.003
1-3	69	27.1	22	33.8	785	24.7	876	25.1	
4-12	51	20.0	11	16.9	487	15.3	549	15.7	
>12	8	3.1	6	9.2	90	2.8	104	3.0	
Unknown	14	5.5	1	1.5	143	4.5	158	4.5	
Total	255	100.0	65	100.0	3177	100.0	3497	100.0	

Table 4.5-41 Lymphovascular space invasion by prioritised ethnicity for patients with colon cancer

Lymphovascular invasion	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	85	33.3	28	43.1	908	28.6	1021	29.2	0.04
No	135	52.9	35	53.8	1842	58.0	2012	57.5	
Unknown	35	13.7	2	3.1	427	13.4	464	13.3	
Total	255	100.0	65	100.0	3177	100.0	3497	100.0	

Table 4.5-42 Differentiation of the tumour by prioritised ethnicity for patients with colon cancer

Differentiation	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Well	41	16.1	24	36.9	521	16.4	586	16.8	0.0009
Moderate	152	59.6	27	41.5	1685	53.0	1864	53.3	
Poor	38	14.9	11	16.9	620	19.5	669	19.1	
Undifferentiated	1	0.4	0	0	30	0.9	31	0.9	
Unknown	23	9.0	3	4.6	321	10.1	347	9.9	
Total	255	100.0	65	100.0	3177	100.0	3497	100.0	

Table 4.5-43 CT scan of the abdomen and pelvis by prioritised ethnicity for patients with colon cancer

CT of abdomen/pelvis within 8 weeks		Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdomen and pelvis**								
Yes	**Within 8 weeks before first treatment**	77	56.6	28	65.1	722	58.5	827	19.9
	Within 8 weeks after first treatment	22	16.2	2	4.7	110	8.9	134	3.2
	None within 8 weeks of first treatment	16	11.8	2	4.7	164	13.3	182	4.4
	Unknown or no treatment	21	15.4	11	25.6	239	19.4	271	6.5
	Total	136	100.0	43	100.0	1235	100.0	1414	34.0
No	**CT of abdomen and pelvis**								
	Within 8 weeks before first treatment	88	54.7	25	62.5	1364	59.2	1477	35.5
	Within 8 weeks after first treatment	20	12.4	1	2.5	222	9.6	243	5.8
	None within 8 weeks of first treatment	36	22.4	8	20.0	509	22.1	553	13.3
	Unknown or no treatment	17	10.6	6	15.0	210	9.1	233	5.6
	Total	161	100.0	40	100.0	2305	100.0	2506	60.2
Unknown	**CT of abdomen and pelvis**								
	Within 8 weeks before first treatment	4	33.3	0	0	93	40.4	97	2.3
	Within 8 weeks after first treatment	2	16.7	0	0	20	8.7	22	0.5
	None within 8 weeks of first treatment	5	41.7	0	0	88	38.3	93	2.2
	Unknown or no treatment	1	8.3	1	100.0	29	12.6	31	0.7
	Total	12	100.0	1	100.0	230	100.0	243	5.8
	Total	309	100.0	84	100.0	3770	100.0	4163	100.0

Table 4.5-44 CT scan of the chest by prioritised ethnicity for patients with colon cancer

CT of chest within 8 weeks		Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of chest**								
Yes	**Within 8 weeks before first treatment**	33	24.3	14	32.6	285	23.1	332	8.0
	Within 8 weeks after first treatment	19	14.0	2	4.7	109	8.8	130	3.1
	None within 8 weeks of first treatment	63	46.3	16	37.2	602	48.7	681	16.4
	Unknown	21	15.4	11	25.6	239	19.4	271	6.5
	Total	136	100.0	43	100.0	1235	100.0	1414	34.0
No	**CT of chest**								
	Within 8 weeks before first treatment	57	35.4	20	50.0	818	35.5	895	21.5
	Within 8 weeks after first treatment	17	10.6	1	2.5	156	6.8	174	4.2
	None within 8 weeks of first treatment	70	43.5	13	32.5	1121	48.6	1204	28.9
	Unknown	17	10.6	6	15.0	210	9.1	233	5.6
	Total	161	100.0	40	100.0	2305	100.0	2506	60.2
Unknown	**CT of chest**								
	Within 8 weeks before first treatment	4	33.3	0	0	74	32.2	78	1.9
	Within 8 weeks after first treatment	0	0	0	0	11	4.8	11	0.3
	None within 8 weeks of first treatment	7	58.3	0	0	116	50.4	123	3.0
	Unknown	1	8.3	1	100.0	29	12.6	31	0.7
	Total	12	100.0	1	100.0	230	100.0	243	5.8
	Total	309	100.0	84	100.0	3770	100.0	4163	100.0

Of the 4180 patients diagnosed with colon cancer who were included in the extended PIPER cohort (years 2006 – 2009) 2906 had non-metastatic disease, and of these 2751 had their primary tumour resected and 2736 had known ethnicity.

Table 4.5-45 Disease outcomes for patients with non-metastatic colon cancer who had their primary resected by prioritised ethnicity

Alive and disease free at 1 year	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
No treatment date*	0	0	0	0	12	0.5	12	0.4	0.01
Sill alive and progression free	91	50.0	33	70.2	1510	60.2	1634	59.7	
Progressed or died within a year	40	22.0	4	8.5	355	14.2	399	14.6	
Progressed or died after 1yr	51	28.0	10	21.3	631	25.2	692	25.3	
Total	182	100.0	47	100.0	2508	100.0	2737	100.0	

*Date of first treatment is unknown

Table 4.5-46 Colonoscopy within 1 year of initial treatment for patients with non-metastatic colon cancer who had their primary resected and who were still alive and progression free at 1 year by prioritised ethnicity

Colonoscopy within 1 year	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	81	57.0	23	53.5	1299	60.7	1403	60.3	0.5
No	61	43.0	20	46.5	842	39.3	923	39.7	
Total	142	100.0	43	100.0	2141	100.0	2326	100.0	

Table 4.5-47 Completeness of staging at diagnosis for patients with non-metastatic colon cancer who were alive and disease free at 1 year by prioritised ethnicity

Completeness of staging	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	55	38.7	16	37.2	876	40.9	947	40.7	0.8
No	87	61.3	27	62.8	1265	59.1	1379	59.3	
Total	142	100.0	43	100.0	2141	100.0	2326	100.0	

Table 4.5-48 Completeness of staging at diagnosis for patients with metastatic colon cancer who were alive and disease free at 1 year by prioritised ethnicity

Completeness of staging (Stage IV)	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	28	45.9	8	44.4	261	47.4	297	47.1	0.95
No	33	54.1	10	55.6	290	52.6	333	52.9	
Total	61	100.0	18	100.0	551	100.0	630	100.0	

4.5.6 Key points: staging for colon cancer

Pathological confirmation of colon cancer

- Pathological confirmation was obtained by colonoscopy for 57% of patients, and at surgery for 32% of patients.
- Higher proportions of independent-urban patients and rural patients had first pathological confirmation at surgery compared to urban patients (36% independent urban, 35% rural, 30% urban). Whilst a higher proportion of independent urban patients present with evidence of obstruction or via the ED this does not explain why a higher proportion of rural patients have first pathology achieved at surgery.
- Less than 5% of patients are diagnosed via CT or other imaging. 4% of patients were diagnosed by sigmoidoscopy.
- Māori were more likely to have first pathological confirmation at surgery (36% compared to 32% for nMnP) while Pacific were least likely (27%). A higher proportion of Pacific people were diagnosed by sigmoidoscopy (10%) compared to Māori (6%) and nMnP (4%).
- Those living in areas with the highest deprivation were most likely to be diagnosed at surgery (50%) and least likely to be diagnosed by colonoscopy (35%). This is consistent with the observation that those from areas with the highest deprivation

have the highest proportions presenting via the emergency department or with obstruction.
- Further analyses are required to understand the relationship between age, staging, ethnicity, deprivation, and rurality.

Synoptic pathology reports

- 56% of patients with a pathology specimen for colon cancer had a synoptic report
- Pathology reports were more frequently reported in synoptic format for urban patients (60%) compared to independent-urban (47%) and rural (46%). Patients from areas with the highest deprivation were least likely to have a synoptic report (NZDep9-10: 51%, compared to the average of 56%). Pacific patients were most likely to have a synoptic report (80%) compared to Māori (45%) and nMnP (54%). The reasons for this are unclear and will require further exploration

Lymph node examination

- For 34% of patients their pathology report stated that fewer than 12 lymph nodes were examined
- This proportion takes into account all patients with a resected primary colon tumour, including those with stage IV who underwent resection of primary
- Urban patients with colon cancer had highest proportion of patients with 12 or more nodes examined (62%), compared to 47% independent urban and 53% rural.
- Urban patients had a higher proportion of patients with N2 disease, with rural patients having higher proportion with N1 disease. Dep 9-10 had the highest proportion of N2 disease compared to other deciles, but no discernible difference in N0 disease.
- Urban patients had highest proportion of well differentiated primary tumour (18%) and rural patients had highest proportion of poorly differentiated primary. Trends for distance from health facility of diagnosis are less clear.
- Māori had a higher proportion of patients with fewer than 12 lymph nodes examined (42%) whereas Pacific people had 85% with 12 or more nodes examined, although small numbers (nMnP 66% had 12 or more nodes examined).
- Māori and Pacific had lower proportions with N0 disease (46% and 39% compared to 54% nMnP) and higher proportions N2 disease (23%, 26% and 18%). Differences in nodal yield by ethnicity may impact on stage migration.
- Māori and Pacific had lower proportions of patients with poorly differentiated tumours

Completeness of staging (defined in methods section)

- Those with acute presentation and non-metastatic disease were less likely to have a CT within 8 weeks before or after treatment than those with non-acute presentation. Independent urban patients were least likely to have complete staging undertaken (43% compared to 48% urban and 46% rural), regardless of whether their presentation was acute or non-acute.
- Similarly, independent urban patients were least likely to have staging completed within 8 weeks before first treatment. The same trend was seen for patients with metastatic disease.

- Those from areas with the highest deprivation were least likely to have complete staging if presenting acutely, but there was no difference by deprivation for those not presenting acutely. At this point the analyses have been adjusted for age, comorbidity or ethnicity.
- Māori had slightly lower proportions of patients with CT of the abdomen/pelvis completed pre-operatively compared to nMnP, but overall had similar levels of incomplete staging. The numbers of Pacific patients were too low for reliable comparisons for staging KPIs.
- Overall, there was very little difference in completeness of staging for non-metastatic disease by ethnicity: 39% for Māori, 37% for Pacific and 41% for nMnP
- For metastatic disease, staging was complete for 46% of Māori, 44% Pacific, 47% nMnP. These comparisons have not yet not been adjusted for age, gender, rurality or deprivation, which is required to further inform interpretation.
- CT of the chest was not considered as a mandatory item for completeness of staging. However independent urban patients were least likely to undergo a chest CT compared to urban and rural patients, regardless of mode of presentation. There was not a clear difference between Māori and nMnP but numbers were small.

Completion colonoscopy (within 6 months pre-diagnosis or 12 months after)

- Overall there were low rates of completion colonoscopy before 12 months post-op and this was lowest for the independent urban group. 62% of eligible urban patients, 56% independent urban and 61% of rural patients had completion procedures undertaken.
- No relationship between deprivation and completeness of colonoscopy has been identified at this point.
- Pacific patients were least likely to undergo completion colonoscopy (54%, Māori 57% and nMnP 61%)

4.5.7 Discussion: staging for colon cancer

Synoptic reporting ensures that a minimum set of information relevant to accurate prognostication or treatment planning is available. Several reports have demonstrated that synoptic reports are more likely to include all relevant information, and may even attenuate the differences in reports between specialist and non-specialist pathologists.[39] The Royal College of Pathologists of Australasia launched its synoptic/structured reporting templates for CRC on 26 February 2010 although it had been implemented to a variable extent prior to this.[40]

During the time period studied for PIPER, 56% of patients had reports that would be considered structured. Independent urban, high deprivation score and Māori patients had the lowest proportions of patients with structured reports. It seems unlikely that a pathology service would have a systematic bias towards reporting or non-reporting in synoptic format for certain groups of patients so it is more likely that this finding is reflective of variation between providers of pathology services. Pacific people had the highest proportion of structured reports, but this may be associated with their predominant urban residence, and

that urban patients are more likely to have pathology reported synoptically. Again this supports a facility effect.

The number of lymph nodes examined is an important measure of quality in colon cancer. An adequate lymph node harvest is required to ensure that a tumour has been staged accurately and that a node-positive patient is not under-reported as having no lymph nodes involved, therefore failing to be considered for adjuvant chemotherapy. It has previously been reported that Māori are more likely to undergo less radical lymph node sampling,[3] but the relationship between location of residence and deprivation has not previously been noted.[19]

In a US population-based study using the SEER database, it was noted that lymph node harvest has increased with time, and that older patients and those with left sided or rectal cancers had lower lymph node counts. It was also noted that geographic location was an important predictor of nodal count.[41] However at initial analysis it seems likely that there is a facility effect for both synoptic reporting and nodal yield above that relating to site of primary tumour, however more sophisticated analyses which adjust for age and other potential confounders such as location of primary tumour need to be undertaken to understand this issue in greater detail.

One potential measure for quality improvement would be to mandate synoptic reporting, and to report total lymph node harvest. This measure would be evidence-based and may lead to a reduction in observed disparities described by our findings

Highlights: Colon Cancer Staging

32% of patients with colon cancer had pathology confirmed for the first time at surgery

34% of pathology reports noted fewer than 12 lymph nodes were examined

56% of pathology reports were in synoptic form for colon cancer

39% of patients had not had complete colonoscopy within a year of diagnosis

41% of patients presenting with non-metastatic and 47% of those presenting with metastatic disease underwent complete staging with colonoscopy and CT of the abdomen and pelvis

4.6 Colon Cancer: Treatment

4.6.1 Non-metastatic colon cancer: surgical treatment

4.6.1.1 Summary of KPIs for surgical treatment of non-metastatic colon cancer

The key performance indicators used for describing the surgical treatment of colon cancer in this section are:

- Removal of primary
- Operation performed
- Completeness of excision
- Length of stay post op
- Return to theatre
- Anastomotic leak
- 30 day mortality post-surgery
- 90 day mortality post-surgery
- MDM Review
- Post-op myocardial infarction
- Post-op pulmonary embolism

Surgery remains the cornerstone of management of non-metastatic colon cancer. Whilst very early T1 tumours without adverse risk features may be managed by polypectomy, few non-metastatic cancers can be treated without major abdominal surgery. Given that the majority of patients with colon cancer have non-metastatic disease, surgical considerations are central to any discussion of outcomes for colon cancer.

Several possible quality indicators exist for colon cancer surgery. Following a process of consultation with key advisors and stakeholders, we selected descriptive measures, outcome measures, and measures that impact on subsequent treatment. Some possible quality indicators are confounded by potential subjective assessment, such as defining anastomotic leak but attempts have been made to minimise subjectivity wherever possible.

In order to understand aspects such as timeliness of the patient journey, decisions around staging, selection for adjuvant and palliative therapy, stoma and reversal rates, as well as morbidity and mortality, we need to describe the characteristics of patients and operations undertaken. Analysis according to rurality, distance to health facility of diagnosis, deprivation and ethnicity was conducted to establish whether there was unequal care delivered by our services to New Zealanders, and to highlight potential further areas for research or quality improvement.

We report 30 and 90 day mortality following surgery and this will allow comparison with the UK National Bowel Cancer Audit. 30 day mortality has been a standard measure of quality of surgical outcomes, however with advances in peri-operative and intensive care support, 90 day mortality is being reported in the UK National Bowel Cancer Audit to account for these advances in supportive care. 90 day mortality has recently been shown to correlate well with mortality at 6 and 12 months following CRC surgery. [42] 12 month and 5 year survival will be presented in later updates of the PIPER project.

Multidisciplinary cancer team meeting (MDM) discussion is mandated for all newly diagnosed cancers in the United Kingdom. At the time of the PIPER cohort, there was no similar requirement in NZ. However we recorded where there was evidence of MDM discussion and this will enable us to establish whether MDM discussion rates had any impact on cancer outcomes or intervention rates.

Here we describe patient characteristics, surgical treatments received, surgical complications, and crude surgical outcome measures.

4.6.1.2 Cohort of patients with non-metastatic colon cancer

The analyses in this section include all patients from the main PIPER cohort (diagnosed in 2007 and 2008) with a site of primary tumour being in the colon and clinical (pre-operative) stage equal to non-metastatic. Of the 3717 patients diagnosed with colon cancer in 2007 and 2008 there were 2607 patients with non-metastatic colon cancer (70% of all colon cancer diagnoses in 2007-2008).

The tables below outline the age, gender and co-morbidity distributions for this cohort by rurality of residence at diagnosis, distance from residence to diagnosis facility and NZ deprivation score. The rural group of patients appear to have a younger age distribution, a higher proportion of males and a lower co-morbidity score than the urban and independent-urban groups (Table 4.6-1, Table 4.6-2, Table 4.6-3). The oldest group of patients tend to live closer to the health facility where their disease was diagnosed (Table 4.6-4) and the proportions of males to females increases with distance from facility of diagnosis (Table 4.6-5). The group of patients who live in areas with higher deprivation scores (more deprived) also appear to be older (a greater proportion of patients 80 years and older) and have higher co-morbidity scores (more co-morbid, Table 4.6-9).

Table 4.6-1 Age (in years) at diagnosis by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

	Rurality of residence at time of diagnosis									
Age at diagnosis	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	31	1.7	3	0.6	4	1.4	1	2.3	39	1.5
40-49	54	3.0	10	2.1	10	3.6	7	15.9	81	3.1
50-59	167	9.2	41	8.7	35	12.5	8	18.2	251	9.6
60-69	401	22.1	105	22.3	84	29.9	12	27.3	602	23.1
70-79	630	34.8	181	38.4	99	35.2	7	15.9	917	35.2
>=80	528	29.2	130	27.6	48	17.1	9	20.5	715	27.4
Unknown	0	0	1	0.2	1	0.4	0	0	2	0.1
Total	1811	100.0	471	100.0	281	100.0	44	100.0	2607	100.0

Table 4.6-2 Gender by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Gender	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	1003	55.4	239	50.7	120	42.7	22	50.0	1384	53.1
Male	808	44.6	232	49.3	161	57.3	22	50.0	1223	46.9
Total	1811	100.0	471	100.0	281	100.0	44	100.0	2607	100.0

Table 4.6-3 C3 Comorbidity score by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

C3 comorbidity score	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	816	45.1	202	42.9	145	51.6	27	61.4	1190	45.6
>0-<1	324	17.9	81	17.2	53	18.9	4	9.1	462	17.7
1-<2	258	14.2	65	13.8	37	13.2	6	13.6	366	14.0
>2	413	22.8	123	26.1	46	16.4	7	15.9	589	22.6
Total	1811	100.0	471	100.0	281	100.0	44	100.0	2607	100.0

* higher scores indicate higher degree of comorbidity

Table 4.6-4 Age at diagnosis by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Age at diagnosis	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	14	1.5	8	1.4	6	1.6	5	1.2	5	1.8	1	2.2	39	1.5
40-49	30	3.3	20	3.5	11	2.9	6	1.4	7	2.5	7	15.2	81	3.1
50-59	73	8.0	55	9.7	41	10.8	43	10.0	30	10.8	9	19.6	251	9.6
60-69	205	22.5	115	20.4	86	22.8	100	23.4	84	30.1	12	26.1	602	23.1
70-79	307	33.7	204	36.1	136	36.0	162	37.9	100	35.8	8	17.4	917	35.2
>=80	281	30.8	163	28.8	98	25.9	111	25.9	53	19.0	9	19.6	715	27.4
Unknown	1	0.1	0	0	0	0	1	0.2	0	0	0	0	2	0.1
Total	911	100.0	565	100.0	378	100.0	428	100.0	279	100.0	46	100.0	2607	100.0

Table 4.6-5 Gender by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

	Distance from residence to facility of diagnosis													
Gender	**0-<5**		**5-<10**		**10-<20**		**20-<50**		**50>/=**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
Female	526	57.7	312	55.2	190	50.3	200	46.7	133	47.7	23	50.0	1384	53.1
Male	385	42.3	253	44.8	188	49.7	228	53.3	146	52.3	23	50.0	1223	46.9
Total	911	100.0	565	100.0	378	100.0	428	100.0	279	100.0	46	100.0	2607	100.0

Table 4.6-6 C3 Comorbidity score by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

	Distance from residence to facility of diagnosis													
C3 comorbidity score	**0-<5**		**5-<10**		**10-<20**		**20-<50**		**50>/=**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
0	417	45.8	238	42.1	168	44.4	211	49.3	127	45.5	29	63.0	1190	45.6
>0-<1	166	18.2	97	17.2	70	18.5	75	17.5	50	17.9	4	8.7	462	17.7
1-<2	120	13.2	78	13.8	62	16.4	67	15.7	33	11.8	6	13.0	366	14.0
>2	208	22.8	152	26.9	78	20.6	75	17.5	69	24.7	7	15.2	589	22.6
Total	911	100.0	565	100.0	378	100.0	428	100.0	279	100.0	46	100.0	2607	100.0

Table 4.6-7 Age at diagnosis by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Age at diagnosis	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	12	2.4	5	0.9	4	0.7	7	1.3	10	2.5	1	1.7	39	1.5
40-49	18	3.6	20	3.8	16	2.7	13	2.4	7	1.7	7	12.1	81	3.1
50-59	51	10.3	60	11.3	44	7.5	49	9.1	39	9.7	8	13.8	251	9.6
60-69	129	26.0	136	25.7	127	21.8	113	21.0	85	21.1	12	20.7	602	23.1
70-79	169	34.0	174	32.8	226	38.8	199	37.1	138	34.3	11	19.0	917	35.2
>=80	117	23.5	135	25.5	165	28.3	156	29.1	123	30.6	19	32.8	715	27.4
Unknown	1	0.2	0	0	1	0.2	0	0	0	0	0	0	2	0.1
Total	497	100.0	530	100.0	583	100.0	537	100.0	402	100.0	58	100.0	2607	100.0

Table 4.6-8 Gender by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Gender	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Female	244	49.1	291	54.9	314	53.9	292	54.4	211	52.5	32	55.2	1384	53.1
Male	253	50.9	239	45.1	269	46.1	245	45.6	191	47.5	26	44.8	1223	46.9
Total	497	100.0	530	100.0	583	100.0	537	100.0	402	100.0	58	100.0	2607	100.0

Table 4.6-9 C3 Comorbidity score by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

C3 comorbidity score	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
0	251	50.5	263	49.6	258	44.3	247	46.0	140	34.8	31	53.4	1190	45.6
>0-<1	94	18.9	96	18.1	109	18.7	83	15.5	73	18.2	7	12.1	462	17.7
1-<2	61	12.3	67	12.6	91	15.6	74	13.8	63	15.7	10	17.2	366	14.0
>2	91	18.3	104	19.6	125	21.4	133	24.8	126	31.3	10	17.2	589	22.6
Total	497	100.0	530	100.0	583	100.0	537	100.0	402	100.0	58	100.0	2607	100.0

To evaluate ethnicity the extended cohort was used (all patients in the main cohort plus all Māori and Pacific patients diagnosed in the calendar years 1 January 2006 – 31 Dec 2006 and 1 Jan 2009 – 31 Dec 2009 and a randomly sampled equal number of nMnP cases over the same time frame). For non-metastatic colon cancer there were an additional 300 patients identified in the extended cohort who have been included in this analysis, giving a total of 2907 patients.

The tables below show the age, gender and co-morbidity distributions for this cohort by ethnicity. The age distribution was youngest for the Pacific patient group, but the Māori group also appeared to be younger than the nMnP group (Table 4.6-10). The Pacific patient group had a higher proportion of male cases than the Māori and nMnP groups (Table 4.6-11). Māori and Pacific patient groups had a lower proportion with a co-morbidity score of zero and a higher proportion with a co-morbidity score of >2 (Māori) and 1-<2 (Pacific) (Table 4.6-12).

Table 4.6-10 Age at diagnosis by prioritised ethnicity for patients with non-metastatic colon cancer

Age at diagnosis	Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	14	7.5	4	7.5	31	1.2	0	0	49	1.7
40-49	12	6.4	7	13.2	83	3.1	2	13.3	104	3.6
50-59	38	20.3	10	18.9	240	9.0	2	13.3	290	10.0
60-69	64	34.2	18	34.0	595	22.4	5	33.3	682	23.5
70-79	40	21.4	9	17.0	954	36.0	3	20.0	1006	34.6
>=80	18	9.6	5	9.4	748	28.2	3	20.0	774	26.6
Unknown	1	0.5	0	0	1	0.0	0	0	2	0.1
Total	187	100.0	53	100.0	2652	100.0	15	100.0	2907	100.0

Table 4.6-11 Gender by prioritised ethnicity for patients with non-metastatic colon cancer

Gender	Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	100	53.5	22	41.5	1403	52.9	6	40.0	1531	52.7
Male	87	46.5	31	58.5	1249	47.1	9	60.0	1376	47.3
Total	187	100.0	53	100.0	2652	100.0	15	100.0	2907	100.0

Table 4.6-12 C3 Comorbidity score by prioritised ethnicity for patients with non-metastatic colon cancer

C3 comorbidity score	Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	65	34.8	18	34.0	1226	46.2	10	66.7	1319	45.4
>0-<1	42	22.5	12	22.6	463	17.5	1	6.7	518	17.8
1-<2	29	15.5	14	26.4	375	14.1	2	13.3	420	14.4
>2	51	27.3	9	17.0	588	22.2	2	13.3	650	22.4
Total	187	100.0	53	100.0	2652	100.0	15	100.0	2907	100.0

4.6.1.3 Rurality of residence at diagnosis for colon cancer

Of the 2607 patients with non-metastatic colon cancer, 44 had unknown rurality status, leaving 2563 patients for the analyses in this section.

Overall 95% (95% CI: 94 to 95) of patients with non-metastatic colon cancer had their primary removed (Table 4.6-13). Patients in rural areas had the highest proportion with removal of primary (99%, p=<0.001; Table 4.6-13); this group of patients appeared to be younger at diagnosis and have lower co-morbidity scores.

Operations performed for the removal of the primary are listed in Table 4.6-14. Some patients had more than one operation to remove their primary. For these cases a "main operation" for the removal of primary was ascertained based on the operations performed and the timing of the operations. This "main operation" has been used for all of the surgical key performance indicators. Some patients had multiple procedures for the removal of their primary within the main operation; 56 patients had 2 procedures for the removal of the primary.

Overall right hemicolectomy was the most frequently performed procedure to remove the primary tumour in non-metastatic colon cancer 41% (95% CI:40 to 43) (Table 4.6-14). Two percent of patients had their primary removed via an endoscopic procedure only. Patients in rural areas had a slightly lower proportion with right hemicolectomy (38% compared with urban 41% and independent urban 40%) and a slightly higher proportion with left hemicolectomy (9% compared with 7% for both urban and independent urban). The proportion with High AR was lowest in patients from independent urban areas (13% compared with 18% for both urban and rural).

Completeness of excision was recorded both macroscopically from the operation note and microscopically from the pathology report for patients who had their primary disease removed (n=2423). Overall 81% of patients with non-metastatic colon cancer who had surgery for removal of their primary disease had complete excision of their disease (95% CI: 79 to 82) (Table 4.6-15). Excision status was unknown for 12% of patients. The rural group had the highest percentage with complete excision (84%) and the lowest percentage of unknowns (10%), while independent urban had the lowest percentage with complete excision resection (76%) but the highest percentage of unknowns (16%) (Table 4.6-15).

Table 4.6-13 Surgery for removal of primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Primary removed	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	1688	93.2	457	97.0	278	98.9	2423	94.5	<0.0001
No	121	6.7	13	2.8	3	1.1	137	5.3	
Unknown	2	0.1	1	0.2	0	0	3	0.1	
Total	1811	100.0	471	100.0	281	100.0	2563	100.0	

Table 4.6-14 Surgical procedure for removal of primary by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Surgical procedure	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Right hemicolectomy	714	41.2	183	39.7	108	38.0	1005	40.5
High AR	304	17.5	59	12.8	50	17.6	413	16.7
Sigmoid colectomy	128	7.4	54	11.7	33	11.6	215	8.7
Left hemicolectomy	126	7.3	31	6.7	24	8.5	181	7.3
Extended right hemicolectomy	130	7.5	29	6.3	17	6.0	176	7.1
Low/Ultra-low AR	88	5.1	28	6.1	11	3.9	127	5.1
Hartmanns	55	3.2	14	3.0	10	3.5	79	3.2
Subtotal colectomy	50	2.9	14	3.0	10	3.5	74	3.0
Transverse colectomy	41	2.4	19	4.1	7	2.5	67	2.7
Other	41	2.4	8	1.7	3	1.1	52	2.1
Endoscopic procedures	28	1.6	15	3.3	4	1.4	47	1.9
Total colectomy	29	1.7	7	1.5	7	2.5	43	1.7
Total	1734	100.0	461	100.0	284	100.0	2479	100.0

Table 4.6-15 Completeness of excision by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Residual disease	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	45	2.7	13	2.8	9	3.2	67	2.8	0.5*
R1 (Microscopic disease)	24	1.4	5	1.1	4	1.4	33	1.4	
R0 (Complete Excision)	1382	81.9	346	75.7	232	83.5	1960	80.9	
RX (Undeterminable)	44	2.6	19	4.2	6	2.2	69	2.8	
R1 (Microscopic disease)-R2 unknown	5	0.3	0	0	0	0	5	0.2	
R0 (Complete Excision)-R2 unknown	57	3.4	26	5.7	6	2.2	89	3.7	
RX (Undeterminable)- R2 unknown	5	0.3	3	0.7	0	0	8	0.3	
Unknown - R2=No	105	6.2	39	8.5	18	6.5	162	6.7	
Unknown	21	1.2	6	1.3	3	1.1	30	1.2	
Total	1688	100.0	457	100.0	278	100.0	2423	100.0	

*p-value compares R2 (Macroscopic disease) , R1 (Microscopic disease) , R0 (Complete Excision), RX (Undeterminable) and all groups with unknown information were excluded

Length of stay in hospital after surgery for removal of primary was determined, excluding patients whose only procedure for the removal of the primary was endoscopic (n=47, Table 4.6-14). Thus the total number of patients included in the assessment of length of stay post-operation was 2376. Overall the median length of stay was 9 days (IQ range 7-13) (Table 4.6-16). There was no variation in the length of stay by urban-rural status (Table 4.6-16). Age, gender and co-morbidity may be influencing these results and further analyses will be conducted to investigate if adjusting for these factors results in differences between the groups.

The proportion of patients who had to return to theatre during the admission for the surgery for removal of their primary disease is provided in Table 4.6-17. Overall, 6% (95% CI: 5 to 7) of patients were returned to theatre. The proportions show little variation by urban-rural status (Table 4.6-17). The effect of age, gender and co-morbidity adjustments on this finding will be reviewed in further analyses.

Table 4.6-18 shows the proportion of patients within each group who had an anastomosis formed as part of their operation for removal of primary, for assessment of anastomotic leak rates (Table 4.6-19). Overall, 4% of non-metastatic colon cancer patients who had an anastomosis formed as part of their operation for removal of primary had evidence of an anastomotic leak (95% CI 3:5) (Table 4.6-19). The unadjusted proportions show minimal variation by urban-rural status.

Table 4.6-16 Length of stay post-operation to remove primary by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Length of stay	Rurality of residence at time of diagnosis			
	Urban	Independent urban	Rural	All
Median	9.0	9.0	9.0	9.0
Lower quartile	7.0	7.0	7.0	7.0
Upper quartile	13.0	12.0	12.0	13.0
Number unknown	209	55	43	307

Table 4.6-17 Evidence of return to theatre post-operation to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Return to theatre	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	107	6.4	28	6.3	16	5.8	151	6.4	0.8
No	1416	85.3	396	89.6	245	89.4	2057	86.6	
Unknown	137	8.3	18	4.1	13	4.7	168	7.1	
Total	1660	100.0	442	100.0	274	100.0	2376	100.0	

Table 4.6-18 Formation of an anastomosis during operation for removal of primary by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Anastomoses formed	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Yes	1589	95.7	423	95.7	264	96.4	2276	95.8
No	44	2.7	13	2.9	7	2.6	64	2.7
Unknown	27	1.6	6	1.4	3	1.1	36	1.5
Total	1660	100.0	442	100.0	274	100.0	2376	100.0

Table 4.6-19 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Anastomotic leak	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	62	3.9	15	3.5	11	4.2	88	3.9	0.9
No	1527	96.1	408	96.5	253	95.8	2188	96.1	
Total	1589	100.0	423	100.0	264	100.0	2276	100.0	

Mortality within 30 days post-operation to remove primary disease was calculated. Patients whose only operation for the removal of the primary was an endoscopic procedure were not included. The overall 30 day mortality for this cohort was 3% (95% CI:3 to 4) (Table 4.6-20).

Mortality within 90 days post-operation was calculated using the same approach as 30 day mortality. The overall 90 day mortality for this cohort was 5% (95% CI: 4 to 6) (Table 4.6-21).The rural group had a lower proportion who died within 90 days post-operation than the urban and independent urban groups (2% compared with 3% and4% respectively) but the differences were not statistically significant (p=0.2).

Patients were classified as having been reviewed at a colorectal multidisciplinary meeting (CRC MDM) if their MDM was within 26 weeks prior to their first treatment or within 12 weeks after their first treatment. Patients who did not receive any treatment (other than palliative care) were classified as having been reviewed at a CRC MDM if their MDM was within 26 weeks prior to or 12 weeks post the date of decision not to treat. Overall 70% of patients had no evidence of review at a CRC MDM (95% CI: 67 to 71) (Table 4.6-22). The rural group had the highest proportion not reviewed (76%) while urban had the lowest proportion not reviewed (68%) Although statistically significantly different (p=0.001), the proportion for whom a review at MDM was unknown was high (overall 16%). Further analyses in the second phase will explore whether there are differences in the proportion with MDM review between the rurality groups.

Table 4.6-20 Mortality within 30 days post-operation to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Mortality within 30days post-surgery	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	54	3.3	19	4.3	5	1.8	78	3.3	0.2
No	1601	96.4	421	95.2	269	98.2	2291	96.4	
Unknown	5	0.3	2	0.5	0	0	7	0.3	
Total	1660	100.0	442	100.0	274	100.0	2376	100.0	

Table 4.6-21 Mortality within 90 days post-operation to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Mortality within 90days post-surgery	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	77	4.6	28	6.3	10	3.6	115	4.8	0.2
No	1578	95.1	412	93.2	264	96.4	2254	94.9	
Unknown	5	0.3	2	0.5	0	0	7	0.3	
Total	1660	100.0	442	100.0	274	100.0	2376	100.0	

Table 4.6-22 Evidence of review at a colorectal multidisciplinary meeting by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

MDM review	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	17	0.9	5	1.1	3	1.1	25	1.0	0.0001
8-0 weeks before first treatment	122	6.7	11	2.3	13	4.6	146	5.7	
Within 4 weeks after first treatment	122	6.7	17	3.6	7	2.5	146	5.7	
Within 4-8 weeks after first treatment	33	1.8	4	0.8	2	0.7	39	1.5	
Within 8-12 weeks after first treatment	11	0.6	0	0	2	0.7	13	0.5	
No	1227	67.8	334	70.9	214	76.2	1775	69.3	
Unknown	279	15.4	100	21.2	40	14.2	419	16.3	
Total	1811	100.0	471	100.0	281	100.0	2563	100.0	

*p-value compares MDM with time frame 26 weeks prior to 12 weeks post first treatment vs. no MDM group.

Evidence of a myocardial infarction (MI) and pulmonary embolism (PE) occurring post-operatively during the admission period for removal of primary disease was collected. Patients whose only procedure for the removal of the primary was endoscopic were not included. Overall 3% of cases who had their primary removed had a post-op MI (95% CI:2 to 4) (Table 4.6-23). Overall fewer than 1% of cases who had their primary removed were recorded as having had a post-operative PE (Table 4.6-24).

Table 4.6-23 Evidence of post-operative myocardial infarction during the admission for surgery to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer

Myocardial infarction occurring during the post op admission period	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	48	2.9	13	2.9	7	2.6	68	2.9	0.9
No	1461	88.0	404	91.4	254	92.7	2119	89.2	
Unknown	151	9.1	25	5.7	13	4.7	189	8.0	
Total	1660	100.0	442	100.0	274	100.0	2376	100.0	

Table 4.6-24 Evidence of post-operative pulmonary embolism during the admission for surgery to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic colon cancer (p-value not calculated due to small numbers with a pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Yes	7	0.4	6	1.4	0	0	13	0.5
No	1502	90.5	411	93.0	261	95.3	2174	91.5
Unknown	151	9.1	25	5.7	13	4.7	189	8.0
Total	1660	100.0	442	100.0	274	100.0	2376	100.0

4.6.1.4 Distance from residence from the health facility of diagnosis for colon cancer

Of the 2607 patients with non-metastatic colon cancer, 46 had unknown distance from their residence to the diagnostic facility, leaving 2561 patients for the analyses in this section.

The group of patients who resided over 50kms from the facility of diagnosis had the highest proportion with their primary removed (99%), while the group of patients who resided 5-10kms from the facility of diagnosis had the lowest proportion with primary removed (91%) (p=<0.0001) (Table 4.6-25). There was very little variation in the surgical procedure performed to remove primary, with the biggest differences seen in the over 50km group compared to all other groups (Table 4.6-26). The proportion with complete excision of primary was similar between the groups (Table 4.6-27).

The median length of stay post-operation for removal of primary showed no variation by distance from residence to health facility of diagnosis (Table 4.6-16). There was very little variation seen in the following KPIs; evidence of return to theatre during this admission period post the operation for removal of primary (range 5-8%; p=0.6) (Table 4.6-29); evidence of anastomotic leak (range 3-5%; p=0.9) (Table 4.6-31); 30 day mortality (range 3-4%, p=0.9;Table 4.6-32) and 90 day mortality (range 4-7%, p=0.5) (Table 4.6-33).

Evidence of any review at a CRC MDM showed variation by distance from residence to health facility of diagnosis, with patients in the over 50km group having the highest proportion not reviewed at an MDM: 76% versus 62-72% for groups living closer to the diagnostic facility (p=0.0001)(Table 4.6-34). However the proportion for whom review at MDM was unknown was high (overall 16%).

There was no evidence of a difference in the proportions with MI or PE by distance of residence from health facility (p=0.8), but the numbers were very small (Table 4.6-35 and Table 4.6-36).

Table 4.6-25 Surgery for removal of primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Primary removed	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	861	94.5	513	90.8	355	93.9	416	97.2	276	98.9	2421	94.5	<.0001
No	50	5.5	51	9.0	22	5.8	12	2.8	2	0.7	137	5.3	
Unknown	0	0	1	0.2	1	0.3	0	0	1	0.4	3	0.1	
Total	911	100.0	565	100.0	378	100.0	428	100.0	279	100.0	2561	100.0	

Table 4.6-26 Surgical procedure for removal of primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Surgical procedure	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Right hemicolectomy	361	41	219	42	160	43.5	159	37.1	105	37.5	1004	40.5
High AR	145	16.5	98	18.8	63	17.1	69	16.1	38	13.6	413	16.7
Sigmoid colectomy	70	8	39	7.5	27	7.3	46	10.7	33	11.8	215	8.7
Left hemicolectomy	69	7.8	26	5	28	7.6	40	9.3	17	6.1	180	7.3
Extended right hemicolectomy	63	7.2	40	7.7	20	5.4	31	7.2	22	7.9	176	7.1
Low/Ultra-low AR	50	5.7	31	6	15	4.1	19	4.4	12	4.3	127	5.1
Hartmanns	28	3.2	12	2.3	11	3	11	2.6	17	6.1	79	3.2
Subtotal colectomy	31	3.5	14	2.7	13	3.5	10	2.3	6	2.1	74	3
Transverse colectomy	26	3	7	1.3	10	2.7	12	2.8	12	4.3	67	2.7
Other	16	1.8	13	2.5	7	1.9	9	2.1	7	2.5	52	2.1
Endoscopic polypectomy	12	1.4	10	1.9	6	1.6	13	3	6	2.1	47	1.9
Total colectomy	9	1	12	2.3	8	2.2	9	2.1	5	1.8	43	1.7
Total	880	100	521	100	368	100	428	100	280	100	2477	100

Table 4.6-27 Completeness of excision by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Residual disease	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	26	3.0	14	2.7	8	2.3	12	2.9	7	2.5	67	2.8	0.5*
R1 (Microscopic disease)	14	1.6	7	1.4	3	0.8	6	1.4	3	1.1	33	1.4	
R0 (Complete Excision)	688	79.9	410	79.9	304	85.6	334	80.3	223	80.8	1959	80.9	
RX (Undeterminable)	26	3.0	16	3.1	5	1.4	16	3.8	6	2.2	69	2.9	
R1 (Microscopic disease)-R2 unknown	2	0.2	1	0.2	2	0.6	0	0	0	0	5	0.2	
R0 (Complete Excision)-R2 unknown	30	3.5	31	6.0	5	1.4	10	2.4	13	4.7	89	3.7	
RX (Undeterminable)- R2 unknown	2	0.2	1	0.2	1	0.3	2	0.5	2	0.7	8	0.3	
Unknown - R2=No	60	7.0	27	5.3	25	7.0	32	7.7	18	6.5	162	6.7	
Unknown	13	1.5	6	1.2	2	0.6	4	1.0	4	1.4	29	1.2	
Total	861	100.0	513	100.0	355	100.0	416	100.0	276	100.0	2421	100.0	

*RX (Undeterminable) and all groups with unknown information were excluded

Table 4.6-28 Length of stay post-operation to remove primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Length of stay	Distance from residence to facility of diagnosis (km)					
	0-<5	5-<10	10-<20	20-<50	50>/=	All
Median	9.0	9.0	9.0	9.0	9.0	9.0
Lower quartile	7.0	7.0	7.0	7.0	7.0	7.0
Upper quartile	13.0	13.0	13.0	13.0	13.0	13.0
Number unknown	99	75	38	49	45	306

Table 4.6-29 Evidence of return to theatre post-operatively during the admission for surgery to remove primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Return to theatre	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	50	5.9	27	5.4	26	7.4	26	6.5	21	7.8	150	6.3	0.6
No	747	88.0	435	86.5	299	85.7	349	86.6	226	83.7	2056	86.6	
Unknown	52	6.1	41	8.2	24	6.9	28	6.9	23	8.5	168	7.1	
Total	849	100.0	503	100.0	349	100.0	403	100.0	270	100.0	2374	100.0	

Table 4.6-30 Formation of an anastomosis during operation for removal of primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Anastomosis formed	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	815	96.0	483	96.0	337	96.6	380	94.3	259	95.9	2274	95.8
No	20	2.4	11	2.2	10	2.9	17	4.2	6	2.2	64	2.7
Unknown	14	1.6	9	1.8	2	0.6	6	1.5	5	1.9	36	1.5
Total	849	100.0	503	100.0	349	100.0	403	100.0	270	100.0	2374	100.0

Table 4.6-31 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Anastomotic leak	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	28	3.4	19	3.9	15	4.5	14	3.7	12	4.6	88	3.9	0.9
No	787	96.6	464	96.1	322	95.5	366	96.3	247	95.4	2186	96.1	
Total	815	100.0	483	100.0	337	100.0	380	100.0	259	100.0	2274	100.0	

Table 4.6-32 Mortality within 30 days post-operation to remove primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Mortality within 30days post-surgery	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	30	3.5	18	3.6	10	2.9	11	2.7	9	3.3	78	3.3	0.9
No	813	95.8	485	96.4	339	97.1	392	97.3	260	96.3	2289	96.4	
Unknown	6	0.7	0	0	0	0	0	0	1	0.4	7	0.3	
Total	849	100.0	503	100.0	349	100.0	403	100.0	270	100.0	2374	100.0	

Table 4.6-33 Mortality within 90 days post-operation to remove primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Mortality within 90days post-surgery	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	42	4.9	25	5.0	14	4.0	16	4.0	18	6.7	115	4.8	0.5
No	801	94.3	478	95.0	335	96.0	387	96.0	251	93.0	2252	94.9	
Unknown	6	0.7	0	0	0	0	0	0	1	0.4	7	0.3	
Total	849	100.0	503	100.0	349	100.0	403	100.0	270	100.0	2374	100.0	

Table 4.6-34 Evidence of review at a colorectal multidisciplinary meeting by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

MDM review	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	6	0.7	11	1.9	2	0.5	3	0.7	3	1.1	25	1.0	<0.0001
8-0 weeks before first treatment	53	5.8	53	9.4	14	3.7	14	3.3	12	4.3	146	5.7	
Within 4 weeks after first treatment	46	5.0	50	8.8	20	5.3	18	4.2	12	4.3	146	5.7	
Within 4-8 weeks after first treatment	13	1.4	9	1.6	8	2.1	7	1.6	2	0.7	39	1.5	
Within 8-12 weeks after first treatment	6	0.7	3	0.5	0	0	3	0.7	1	0.4	13	0.5	
No	653	71.7	350	61.9	259	68.5	298	69.6	213	76.3	1773	69.2	
Unknown	134	14.7	89	15.8	75	19.8	85	19.9	36	12.9	419	16.4	
Total	911	100.0	565	100.0	378	100.0	428	100.0	279	100.0	2561	100.0	

Table 4.6-35 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer

Myocardial infarction occurring during the post op admission period	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	25	2.9	13	2.6	8	2.3	15	3.7	7	2.6	68	2.9	0.8
No	764	90.0	444	88.3	315	90.3	355	88.1	239	88.5	2117	89.2	
Unknown	60	7.1	46	9.1	26	7.4	33	8.2	24	8.9	189	8.0	
Total	849	100.0	503	100.0	349	100.0	403	100.0	270	100.0	2374	100.0	

Table 4.6-36 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic colon cancer (p-value not calculated due to small numbers of pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	5	0.6	2	0.4	1	0.3	3	0.7	2	0.7	13	0.5
No	785	92.5	455	90.5	321	92.0	366	90.8	245	90.7	2172	91.5
Unknown	59	6.9	46	9.1	27	7.7	34	8.4	23	8.5	189	8.0
Total	849	100.0	503	100.0	349	100.0	403	100.0	270	100.0	2374	100.0

4.6.1.5 Area deprivation of residence at diagnosis for colon cancer

Of the 2607 patients with non-metastatic colon cancer, 58 had unknown deprivation score at diagnosis, leaving 2549 patients for the analyses in this section.

There was little variation between deprivation groups in the proportion of patients who had their primary removed. The lowest proportion was seen for the most deprived group (group 9-10, 92%)(p=0.05) (Table 4.6-37).The surgical procedure performed to remove primary and the proportion with complete excision also showed little variation between groups (Table 4.6-38, Table 4.6-39).

The median length of stay post-operation for removal of primary showed no variation by deprivation, however the upper quartile was higher for patients from areas of high deprivation (9-10)(14 days vs. 13 for the rest) and the lower quartile was lowest for patients from areas with the least deprivation (1-2) (6 days vs. 7 for the rest) (Table 4.6-40). The proportion of patients returning to theatre increased with deprivation (1-2: 5% vs. 8-9: 8%) (p=0.04) (Table 4.6-41). There was a small trend of increasing deprivation and increasing proportion with anastomotic leak (Table 4.6-43) however this was not statistically significant (p=0.4). A similar trend was seen between 30 day mortality and increasing deprivation, however again this was not statistically significant (p=0.2; Table 4.6-44).90 day mortality showed a clearer trend between worsening deprivation and higher mortality, with a p-value of 0.03 (Table 4.6-45).

The proportions with evidence of any review at a CRC MDM showed some variation by deprivation. Patients from areas with the highest deprivation (9-10) had a lower proportion not reviewed at an MDM than patients from areas with the lowest deprivation (1-2), 64% versus 74% respectively (Table 4.6-46)), although the differences were not statistically significant (p=0.5). The large number of patients whom MDM review is unknown could also be affecting these results.

Comparison of un-adjusted proportions based on a small number of events suggested some variation in the proportion of patients who had evidence of an MI and PE during the period post-operation for removal of primary until discharge by deprivation score, particularly for MI where deprivation score groups 5-6 and 7-8 have a higher proportion than the total (4% vs. 3%)(p=0.2) (Table 4.6-47).

Further analysis of these KPIs will be carried out where there are sufficient numbers to adjust for co-morbidity as well as age and gender.

Table 4.6-37 Surgery for removal of primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Primary removed	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	475	95.6	498	94.0	559	95.9	509	94.8	369	91.8	2410	94.5	0.045
No	22	4.4	30	5.7	23	3.9	28	5.2	33	8.2	136	5.3	
Unknown	0	0	2	0.4	1	0.2	0	0	0	0	3	0.1	
Total	497	100.0	530	100.0	583	100.0	537	100.0	402	100.0	2549	100.0	

Table 4.6-38 Surgical procedure for removal of primary by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Surgical procedure	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Right hemicolectomy	201	41.6	201	39.4	244	42.5	199	38.3	152	40.2	997	40.5
High AR	78	16.1	90	17.6	93	16.2	90	17.3	59	15.6	410	16.6
Sigmoid colectomy	39	8.1	45	8.8	43	7.5	45	8.7	42	11.1	214	8.7
Left hemicolectomy	35	7.2	38	7.5	42	7.3	42	8.1	24	6.3	181	7.3
Extended right hemicolectomy	33	6.8	40	7.8	43	7.5	39	7.5	21	5.6	176	7.1
Low/Ultra-low AR	26	5.4	20	3.9	30	5.2	27	5.2	24	6.3	127	5.2
Hartmanns	11	2.3	12	2.4	21	3.7	18	3.5	17	4.5	79	3.2
Subtotal colectomy	11	2.3	21	4.1	18	3.1	14	2.7	10	2.6	74	3.0
Transverse colectomy	15	3.1	12	2.4	20	3.5	14	2.7	5	1.3	66	2.7
Other	12	2.5	13	2.5	7	1.2	14	2.7	5	1.3	51	2.1
Endoscopic polypectomy	7	1.4	9	1.8	9	1.6	11	2.1	10	2.6	46	1.9
Total colectomy	15	3.1	9	1.8	4	0.7	6	1.2	9	2.4	43	1.7
Total	483	100.0	510	100.0	574	100.0	519	100.0	378	100.0	2464	100.0

Table 4.6-39 Completeness of excision by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Residual disease	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	9	1.9	16	3.2	15	2.7	15	2.9	12	3.3	67	2.8	0.5*
R1 (Microscopic disease)	3	0.6	9	1.8	11	2.0	6	1.2	4	1.1	33	1.4	
R0 (Complete Excision)	386	81.3	400	80.3	458	81.9	404	79.4	300	81.3	1948	80.8	
RX (Undeterminable)	14	2.9	13	2.6	13	2.3	14	2.8	15	4.1	69	2.9	
R1 (Microscopic disease)-R2 unknown	0	0	2	0.4	1	0.2	2	0.4	0	0	5	0.2	
R0 (Complete Excision)-R2 unknown	25	5.3	12	2.4	21	3.8	25	4.9	6	1.6	89	3.7	
RX (Undeterminable)- R2 unknown	1	0.2	2	0.4	1	0.2	1	0.2	3	0.8	8	0.3	
Unknown - R2=No	31	6.5	37	7.4	29	5.2	39	7.7	25	6.8	161	6.7	
Unknown	6	1.3	7	1.4	10	1.8	3	0.6	4	1.1	30	1.2	
Total	475	100.0	498	100.0	559	100.0	509	100.0	369	100.0	2410	100.0	

*p-value compares R2 (Macroscopic disease) , R1 (Microscopic disease) , R0 (Complete Excision), RX (Undeterminable) and all groups with unknown information were excluded

Table 4.6-40 Length of stay post-operation to remove primary by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Length of stay	NZ Deprivation Index of residence at time of diagnosis					
	1-2	3-4	5-6	7-8	9-10	*All*
Median	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**
Lower quartile	**6.0**	**7.0**	**7.0**	**7.0**	**7.0**	**7.0**
Upper quartile	**13.0**	**13.0**	**13.0**	**13.0**	**14.0**	**13.0**
Number unknown	**92**	**84**	**62**	**43**	**22**	**303**

Table 4.6-41 Evidence of return to theatre post-operatively during the admission for surgery to remove primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Return to theatre	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	22	4.7	26	5.3	39	7.1	37	7.4	27	7.5	151	6.4	0.04
No	389	83.1	425	86.9	472	85.8	439	88.2	323	90.0	2048	86.6	
Unknown	57	12.2	38	7.8	39	7.1	22	4.4	9	2.5	165	7.0	
Total	468	100.0	489	100.0	550	100.0	498	100.0	359	100.0	2364	100.0	

Table 4.6-42 Formation of an anastomosis during operation for removal of primary by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Anastomosis formed	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	443	94.7	473	96.7	527	95.8	478	96.0	343	95.5	2264	95.8
No	13	2.8	8	1.6	15	2.7	13	2.6	15	4.2	64	2.7
Unknown	12	2.6	8	1.6	8	1.5	7	1.4	1	0.3	36	1.5
Total	468	100.0	489	100.0	550	100.0	498	100.0	359	100.0	2364	100.0

Table 4.6-43 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Anastomotic leak	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	13	2.9	14	3.0	23	4.4	22	4.6	16	4.7	88	3.9	0.4
No	430	97.1	459	97.0	504	95.6	456	95.4	327	95.3	2176	96.1	
Total	443	100.0	473	100.0	527	100.0	478	100.0	343	100.0	2264	100.0	

Table 4.6-44 Mortality within 30 days post-operation to remove primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Mortality within 30days post-surgery	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	9	1.9	14	2.9	20	3.6	17	3.4	18	5.0	78	3.3	0.2
No	456	97.4	473	96.7	529	96.2	480	96.4	341	95.0	2279	96.4	
Unknown	3	0.6	2	0.4	1	0.2	1	0.2	0	0	7	0.3	
Total	468	100.0	489	100.0	550	100.0	498	100.0	359	100.0	2364	100.0	

Table 4.6-45 Mortality within 90 days post-operation to remove primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Mortality within 90days post-surgery	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	16	3.4	21	4.3	25	4.5	24	4.8	29	8.1	115	4.9	0.03
No	449	95.9	466	95.3	524	95.3	473	95.0	330	91.9	2242	94.8	
Unknown	3	0.6	2	0.4	1	0.2	1	0.2	0	0	7	0.3	
Total	468	100.0	489	100.0	550	100.0	498	100.0	359	100.0	2364	100.0	

Table 4.6-46 Evidence of review at a colorectal multidisciplinary meeting by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

MDM review	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	4	0.8	6	1.1	4	0.7	7	1.3	4	1.0	25	1.0	0.5
8-0 weeks before first treatment	30	6.0	31	5.8	28	4.8	35	6.5	21	5.2	145	5.7	
Within 4 weeks after first treatment	29	5.8	29	5.5	34	5.8	28	5.2	23	5.7	143	5.6	
Within 4-8 weeks after first treatment	10	2.0	4	0.8	4	0.7	11	2.0	8	2.0	37	1.5	
Within 8-12 weeks after first treatment	1	0.2	4	0.8	3	0.5	2	0.4	3	0.7	13	0.5	
No	366	73.6	362	68.3	423	72.6	364	67.8	257	63.9	1772	69.5	
Unknown	57	11.5	94	17.7	87	14.9	90	16.8	86	21.4	414	16.2	
Total	497	100.0	530	100.0	583	100.0	537	100.0	402	100.0	2549	100.0	

*p-value compares MDM with time frame 26 weeks prior to 12 weeks post first treatment vs. no MDM group.

Table 4.6-47 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer

Myocardial infarction occurring during the post op admission period	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	8	1.7	9	1.8	19	3.5	20	4.0	11	3.1	67	2.8	0.2
No	402	85.9	436	89.2	488	88.7	452	90.8	333	92.8	2111	89.3	
Unknown	58	12.4	44	9.0	43	7.8	26	5.2	15	4.2	186	7.9	
Total	468	100.0	489	100.0	550	100.0	498	100.0	359	100.0	2364	100.0	

Table 4.6-48 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by area deprivation score for residence at the time of diagnosis for patients with non-metastatic colon cancer (p-value not calculated due to small numbers with pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	1	0.2	0	0	3	0.5	6	1.2	3	0.8	13	0.5
No	408	87.2	445	91.0	505	91.8	466	93.6	341	95.0	2165	91.6
Unknown	59	12.6	44	9.0	42	7.6	26	5.2	15	4.2	186	7.9
Total	468	100.0	489	100.0	550	100.0	498	100.0	359	100.0	2364	100.0

4.6.1.6 Ethnicity for colon cancer

Of the 2907 patients in the extended PIPER cohort diagnosed with non-metastatic colon cancer, 15 had unknown ethnicity, leaving 2892 patients for the analyses in this section.

The proportion of Māori patients with their primary removed was higher than the proportion for nMnP (97% vs. 95% respectively), and the proportion of Pacific patients with their primary removed was lower than the proportion of nMnP (89% vs. 95% respectively), p=0.04 (Table 4.6-50). These preliminary finding are unadjusted for age, gender and co-morbidity, and these factors may account for this difference.

The surgical procedure performed showed some variation by ethnicity, with Māori and Pacific patients having lower proportions undergoing right hemicolectomy than nMnP (30% and 31% vs. 41% respectively) (Table 4.6-50). The associations between gender and ethnicity and sidedness of disease may be playing a role in this finding. The proportion of Māori patients with complete excision of disease was 82%, whereas for Pacific patients it was 92% and for nMnP 81%, but the difference was not statistically significant (p=0.4) (Table 4.6-51).

The median length of stay post-operation for removal of primary showed some variation by ethnicity (10 days for Māori, 8.5 for Pacific and 9 days for nMnP). The upper quartile was highest for Māori patients and lowest for Pacific patients (15 and 12 days respectively vs. 13 days for nMnP) (Table 4.6-52). Age and comorbidity are likely to be influencing this comparison. Māori patients had the highest proportion with evidence of return to theatre during the admission period post-operation for removal of primary (11% vs. 9% in Pacific and 6% in nMnP) (Table 4.6-53). Māori patients also had the highest proportion with anastomotic leak (9% vs. 7% in Pacific and 4% in nMnP) (Table 4.6-55). 30 day mortality proportions were similar between Māori and nMnP (both 3%) (Table 4.6-56). There were no instances of death within 30 days of operation to remove primary in Pacific patients (Table 4.6-56), however there were only 47 Pacific patients in the cohort who had surgical removal of their primary disease. 90 day mortality showed more variation with Māori having a slightly higher proportion than nMnP (6% vs. 5%) and Pacific having a lower proportion (2%) (Table 4.6-57), although the difference was not statistically significant (p=0.5).

Evidence of any review at a CRC MDM showed variation by ethnicity, with Māori and Pacific patients having a lower proportion not reviewed at an MDM than nMnP patients (62% and 59% respectively vs. 68%) (p=0.001), however the proportion of cases where review at MDM was unknown was high (Table 4.6-58).

Evidence of MI and PE during the period post-operation for removal of primary until discharge is also presented. The number of occurrences of MI and PE across all groups, but particularly Māori and Pacific, were very low, with too few numbers to make useful statistical comparisons. (Table 4.6-59, Table 4.6-60).

Variations in the above surgical indicators are likely to reflect differences in clinical characteristics of the patients, such as stage of disease, and demographic characteristics, such as age. Further analysis of the reasons for observed differences in the crude proportions will be carried out in the second phase of our analysis, where numbers allow.

Table 4.6-49 Surgery for removal of primary disease by prioritised ethnicity for patients with non-metastatic colon cancer

Primary removed	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	182	97.3	47	88.7	2508	94.6	2737	94.6	0.04
No	5	2.7	6	11.3	140	5.3	151	5.2	
Unknown	0	0	0	0	4	0.2	4	0.1	
Total	187	100.0	53	100.0	2652	100.0	2892	100.0	

Table 4.6-50 Surgical procedure for removal of primary by prioritised ethnicity for patients with non-metastatic colon cancer

Surgical procedure	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Right hemicolectomy	56	29.9	15	31.3	1054	41.1	1125	40.1
High AR	34	18.2	11	22.9	419	16.3	464	16.6
Sigmoid colectomy	21	11.2	4	8.3	218	8.5	243	8.7
Left hemicolectomy	17	9.1	1	2.1	191	7.4	209	7.5
Extended right hemicolectomy	10	5.3	3	6.3	184	7.2	197	7.0
Low/Ultra-low AR	18	9.6	3	6.3	118	4.6	139	5.0
Hartmanns	11	5.9	4	8.3	78	3.0	93	3.3
Subtotal colectomy	5	2.7	1	2.1	76	3.0	82	2.9
Transverse colectomy	6	3.2	0	0	69	2.7	75	2.7
Other	5	2.7	3	6.3	62	2.4	70	2.5
Endoscopic polypectomy	2	1.1	0	0	51	2.0	53	1.9
Total colectomy	2	1.1	3	6.3	47	1.8	52	1.9
Total	187	100.0	48	100.0	2567	100.0	2802	100.0

Table 4.6-51 Completeness of excision by prioritised ethnicity for patients with non-metastatic colon cancer

Residual disease	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	4	2.2	3	6.4	68	2.7	75	2.7	0.4
R1 (Microscopic disease)	4	2.2	0	0	35	1.4	39	1.4	
R0 (Complete Excision)	149	81.9	43	91.5	2025	80.7	2217	81.0	
RX (Undeterminable)	8	4.4	0	0	65	2.6	73	2.7	
R1 (Microscopic disease)-R2 unknown	0	0	0	0	6	0.2	6	0.2	
R0 (Complete Excision)-R2 unknown	4	2.2	0	0	113	4.5	117	4.3	
RX (Undeterminable)- R2 unknown	2	1.1	0	0	7	0.3	9	0.3	
Unknown - R2=No	9	4.9	1	2.1	161	6.4	171	6.2	
Unknown	2	1.1	0	0	28	1.1	30	1.1	
Total	182	100.0	47	100.0	2508	100.0	2737	100.0	

*p-value compares R2 (Macroscopic disease) , R1 (Microscopic disease) , R0 (Complete Excision), RX (Undeterminable) and all groups with unknown information were excluded

Table 4.6-52 Length of stay post-operation to remove primary by prioritised ethnicity for patients with non-metastatic colon cancer

Length of stay	Prioritised Ethnicity			
	Māori	Pacific	nMnP	*All*
Median	**10.0**	**8.5**	**9.0**	**9.0**
Lower quartile	**7.0**	**7.0**	**7.0**	**7.0**
Upper quartile	**15.0**	**12.0**	**13.0**	**13.0**
Number unknown	**13**	**1**	**348**	**362**

Table 4.6-53 Evidence of return to theatre post-operatively during the admission for surgery to remove primary disease by prioritised ethnicity for patients with non-metastatic colon cancer

Return to theatre	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	19	10.6	4	8.5	145	5.9	168	6.3	0.08
No	158	87.8	43	91.5	2108	85.8	2309	86.0	
Unknown	3	1.7	0	0	204	8.3	207	7.7	
Total	180	100.0	47	100.0	2457	100.0	2684	100.0	

Table 4.6-54 Formation of an anastomosis during operation for removal of primary by prioritised ethnicity for patients with non-metastatic colon cancer

Anastomosis formed	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Yes	167	92.8	46	97.9	2339	95.2	2552	95.1
No	11	6.1	1	2.1	61	2.5	73	2.7
Unknown	2	1.1	0	0	57	2.3	59	2.2
Total	180	100.0	47	100.0	2457	100.0	2684	100.0

Table 4.6-55 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by prioritised ethnicity for patients with non-metastatic colon cancer

Anastomotic leak	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	15	9.0	3	6.5	80	3.4	98	3.8	0.0009
No	152	91.0	43	93.5	2259	96.6	2454	96.2	
Total	167	100.0	46	100.0	2339	100.0	2552	100.0	

Table 4.6-56 Mortality within 30 days post-operation to remove primary disease by prioritised ethnicity for patients with non-metastatic colon cancer

Mortality within 30days post-surgery	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	6	3.3	0	0	78	3.2	84	3.1	0.46
No	172	95.6	47	100.0	2370	96.5	2589	96.5	
Unknown	2	1.1	0	0	9	0.4	11	0.4	
Total	180	100.0	47	100.0	2457	100.0	2684	100.0	

Table 4.6-57 Mortality within 90 days post-operation to remove primary disease by prioritised ethnicity for patients with non-metastatic colon cancer

Mortality within 90days post-surgery	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	11	6.1	1	2.1	114	4.6	126	4.7	0.5
No	167	92.8	46	97.9	2334	95.0	2547	94.9	
Unknown	2	1.1	0	0	9	0.4	11	0.4	
Total	180	100.0	47	100.0	2457	100.0	2684	100.0	

Table 4.6-58 Evidence of review at a colorectal multidisciplinary meeting by prioritised ethnicity for patients with non-metastatic colon cancer

MDM review	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	4	2.1	2	3.8	25	0.9	31	1.1	0.001
8-0 weeks before first treatment	13	7.0	7	13.2	150	5.7	170	5.9	
Within 4 weeks after first treatment	15	8.0	6	11.3	153	5.8	174	6.0	
Within 4-8 weeks after first treatment	5	2.7	1	1.9	40	1.5	46	1.6	
Within 8-12 weeks after first treatment	1	0.5	0	0	14	0.5	15	0.5	
No	116	62.0	31	58.5	1813	68.4	1960	67.8	
Unknown	33	17.6	6	11.3	457	17.2	496	17.2	
Total	187	100.0	53	100.0	2652	100.0	2892	100.0	

*p-value compares MDM with time frame 26 weeks prior to 12 weeks post first treatment vs. no MDM group.

Table 4.6-59 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by prioritised ethnicity for patients with non-metastatic colon cancer

Myocardial infarction occurring during the post op admission period	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	2	1.1	0	0	71	2.9	73	2.7	0.1
No	175	97.2	47	100.0	2161	88.0	2383	88.8	
Unknown	3	1.7	0	0	225	9.2	228	8.5	
Total	180	100.0	47	100.0	2457	100.0	2684	100.0	

Table 4.6-60 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by prioritised ethnicity for patients with non-metastatic colon cancer

Pulmonary embolism occurring during the post op admission period	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Yes	1	0.6	0	0	14	0.6	15	0.6
No	176	97.8	47	100.0	2218	90.3	2441	90.9
Unknown	3	1.7	0	0	225	9.2	228	8.5
Total	180	100.0	47	100.0	2457	100.0	2684	100.0

4.6.1.7 Summary of key points: surgical treatment of non-metastatic colon cancer

Characteristics of patients with non-metastatic colon cancer:

- Patients from rural areas had a younger age distribution, a higher proportion of males and a lower C3 comorbidity score.
- Those with greater socioeconomic deprivation (measured by NZ Dep Score) had greater proportions with high C3 co-morbidity scores (1-2 and >2).
- The Pacific patient group had a younger age distribution than Māori and nMnP; Māori had a younger age distribution than nMnP.
- The Pacific patient group had a greater proportion of males (59%) compared to Māori (47%) and nMnP (47%).
- Māori and Pacific patients had a lower proportion with a C3 comorbidity score of 0 (35% and 34% respectively) and the highest proportion with a score of >2 (Māori; 27%) and 1-2 (Pacific; 26%).

Removal of primary:

- Overall approximately 95% of those with non-metastatic colon cancer had their primary removed.
- Rural patients had the highest proportion with their primary removed (99%). The rural patient population appears to be younger at diagnosis; the relationship between age, gender, comorbidity and removal of primary will be further analysed.
- Pacific patients and those with the highest deprivation score (9-10) had the lowest proportion with their primary removed (89% and 92%). Note that Pacific also have the largest proportion with unknown removal of primary (6%). Co-morbidity is likely to be an important factor here and will be adjusted for in further analyses, along with age and gender.

Operation performed:

- Overall the most frequently performed operation for removal of primary was right hemicolectomy (41%). 2% of patients had their primary removed endoscopically only.
- Patients residing in rural areas had a lower proportion who had right hemicolectomy (38%) than urban and independent urban patient groups.
- Māori and Pacific patients had lower proportions with right hemicolectomy (30% and 31% respectively, compared to 41% for nMnP).The differences in operation may be related to differences in location of tumour by age, gender and ethnicity; this will be evaluated in future analyses.

Residual disease post resection:

- Overall 81% of those with non-metastatic colon cancer who had their primary removed had complete excision recorded. This information was missing for 12% of cases.
- Rural patients had the highest proportion with complete excision (84%) and the least unknown (10%), while independent urban had the lowest proportion with complete excision (76%) but the highest proportion unknown (16%). These populations also

have different age and comorbidity distributions, which could be influencing these results.
- Pacific patients had the highest proportion with complete excision (92%), however also had the highest proportion with R2 disease (6%).

Length of stay:

- Overall the median length of stay was 9 days (IQ range 7-13).
- There was no variation in the median number of days by rurality, distance to diagnosis facility, deprivation score or ethnicity.
- Age, gender and co-morbidity may be influencing these results and further analyses will be conducted.

Return to theatre:

- Overall 6% of patients returned to theatre within their admission for removal of primary disease.
- Patients from areas of high deprivation had a slightly higher proportion who returned to theatre (range 7-8% compared with 5% in areas of lower deprivation).
- The proportion of Māori who returned to theatre was the highest (11%) followed by Pacific (9%) and nMnP (6%).

Anastomotic leak:

- Overall approximately 95% of patients who had a resection of their primary had an anastomosis formed. Of these 4% had evidence of an anastomotic leak.
- Māori patients had highest proportion with an anastomotic leak (9%), compared with Pacific patients (7%) and nMnP (4%). This finding requires exploration with age, gender and co-morbidity adjusted analysis.

30 day post-op mortality:

- The overall 30 day mortality was 3%.

90 day post-op mortality:

- The overall 90 day mortality was 5%
- Patients living in rural areas had a slightly lower 90 day mortality (4%), possibly due to being a younger population. For patients from independent urban areas the 90 day mortality was slightly higher at 6% than in urban or rural areas.
- Patients from areas with the least deprivation had the lowest 90 day mortality. Those from areas with the highest deprivation had the highest 90 day mortality (8%). The role of co-morbidity will be investigated with further analyses.
- Māori had a slightly higher 90 day mortality at 6%. Pacific had lower 90 day mortality (2%) but have a small number of patients overall.

MDM Review:

- Overall, 70% of patients had no evidence of review at a colorectal MDM.

- The rural group of patients had the highest proportion not reviewed (76%) while urban patients had the lowest proportion not reviewed (68%).
- The group of patients living over 50km from the diagnostic facility had the highest proportion not reviewed (76%). Those living 5-10km away had the lowest proportion not reviewed (62%).
- The patient group from the least deprived area had the highest proportion not reviewed (74%) while those from the most deprived areas had the lowest proportion not reviewed (64%).
- Pacific patients had the lowest proportion not reviewed overall (59%), and Māori had a lower proportion not reviewed than nMnP (62% vs. 68%). This and the differences by deprivation may be related to co-morbidity and surgery in the private sector. This will be evaluated in future analyses.

Post-op myocardial infarction (MI)

- Overall 3% of patients with their primary removed had a post-op MI.

Post-op pulmonary embolism (PE)

- Overall 0.5% of patients with their primary removed had a documented post-op PE. There were very few occurrences across the whole cohort, limiting the comparison of groups of patients. The low rates may reflect the limitations of data capture.

4.6.1.8 Discussion: surgical treatment of non-metastatic colon cancer

As described elsewhere in this project, patients living in rural areas and Māori have a younger age distribution than urban residents and nMnP respectively. These factors may be influencing the comparison of KPIs - we have planned subsequent analyses to further explore relationships between the KPIs and age, gender, comorbidity, rurality, distance to health facility of diagnosis, deprivation status, and ethnicity.

95% of our cohort with non-metastatic CRC underwent a resection of their primary tumour – the single most important variable related to survival from CRC. We found that 2% of patients underwent endoscopic resection only without subsequent colonic resectional surgery. It is likely that the majority of the patients with endoscopic resection only are those with very localised cancers (or considerable comorbidity) and demonstrates that overall, endoscopic resection of colon cancer is a very small fraction of the overall number of resections undertaken. We did not have sufficient project resource to collect detailed amounts of pathological detail that may be relevant to polyp-cancers, and so further analysis of this small group of the cohort will be unlikely to yield additional information.

The R status (extent of resection – complete, microscopically involved margins, or macroscopic residual disease) is an important prognostic variable. R1 and R2 status are adverse prognostic factors compared with R0 status at any stage of disease.[43] An R2 resection is considered a palliative operation. The presence of R1 disease reflects involved surgical margins, and may indicate disease that is technically difficult to resect, or that slightly more radical surgery was required to achieve clear margins. In some case series, the 5 year overall survival for R0

cancers is 82% whereas R1+R2 is 35%, although the relative contributions of disease or technical factors to this difference in outcome is difficult to ascertain.[44]

Our study found an R0 resection described in 81% of notes, with 12% unknown or missing. This suggests that the rate of R1 or R2 resection is between 7-17%. The FOXTROT clinical trial randomises patients with locally advanced colon cancer to either pre-operative chemotherapy then surgery, or to surgery then post-operative chemotherapy. In early results, the rate of margin involvement (R1) was 4% in those treated with pre-operative chemotherapy compared to 20% with surgery first. [45] This result may be of relevance to the group of patients with characteristics currently achieving R1 or R2 resection.

Our project involved hand-searching patient records and pathology results and we were unable to identify R status for 12% of patients, which seems a high level of missing data for an important prognostic variable, although it is difficult to find comparator data sets. The US SEER database for example does not report on R status for CRC. Synoptic reporting may be one way of improving collection of R status, and this could then be collected and utilised by cancer services for monitoring and interpreting outcome data.

The median length of hospital stay for patients in this cohort with non-metastatic colon cancer was 9 days. This is comparable to the average length of stay seen in the open surgery arm of the COLOR randomised trial of open vs. laparoscopic colon cancer surgery [46] although the median length of stay in the COST trial (also of laparoscopic v open surgery) was 6 days for open surgery. [47] The UK National Bowel Cancer audit reports median length of stay of 7 days for colon cancer and 8 days for rectal cancer. Interest has grown in enhanced recovery after surgery (ERAS) pathways which can shorten median length of stay by two days and reduce non-surgical complications without increasing surgical morbidity or mortality. These meta-analyses demonstrate that shortened length of stay can be better for patients as well as reducing health-care system costs.[48, 49] The impact of ERAS programmes in a NZ context could be a valuable area for further attention from researchers and providers.

Unplanned return to theatre is associated with higher one year mortality, is an indicator of severe post-operative complication, and is influenced by patient comorbidity.[50] We observed an overall return to theatre rate of 6%, with slightly higher proportions of patients from the group with higher socioeconomic deprivation having higher rates of return, and Māori having the highest rate of return (11%). These analyses are provisional and have not been adjusted for age or comorbidity which may vary the interpretation of these proportions.

The rate of return to theatre is similar to that in published data from the UK.[51] The UK dataset notes significant regional, institutional, and operator variability in the crude rate, and there was no clear association with case load. Further analysis of the PIPER dataset with adjustment for comorbidity, presentation (acute or elective), age, ethnicity, health facility of diagnosis, and case-load could provide further insight into factors related to return to theatre that may be amenable to intervention. Overall it is reassuring to see the rate of return to theatre comparable to international data.

We report an anastomotic leak rate of 4%. However it is likely to be subject to considerable reporting bias. Previously, no universal definition has existed[52] although a three tier grading

system has recently been recommended for leaks associated with rectal cancer.[53] If the surgical community consider anastomotic leak rate to be an important indicator of quality, further work will need to be undertaken to achieve consensus on definitions and standardisation of reporting.

Variations in leak rate by ethnicity will need to be explored by in relation to comorbidity and age, however we note that Māori and Pacific both have higher leak rates than nMnP.

The 30 day mortality in this cohort was 3% and at 90 days was 5%. Improvements in post-operative supportive care and some very prolonged admissions result in some surgical deaths no longer being captured in a report by 30 day mortality. Therefore many have argued for the extension of reporting to 90 days, as this proportion is closely correlated with one year survival.

As has been reported elsewhere, those with greatest socioeconomic deprivation have the highest 90 day mortality.[54] Previous reports have noted that once adjustments are undertaken for emergency surgery, anastomotic leak, comorbidity and age, that deprivation status is no longer a significant predictor of mortality.

We collected data on reported myocardial infarctions and post-operative pulmonary embolus during the post-operative admission period, which are both medically significant complications that could influence recovery, mortality, and fitness for post-operative chemotherapy. Surprisingly, we found evidence of pulmonary embolus in only 0.5% of all cases. Elsewhere, rates of 2% have been recorded from national surveys,[55] whereas in clinical studies where compression ultrasonography is used, 9.7% of patients are found to have DVT or PE. [56] This disparity in findings suggests that current methods of identifying post-operative complications from discharge summaries may under-report actual rates of VTE, or that clinically significant VTE rates differ from those found in clinical studies.

Overall, we found that 70% of patient notes contained no evidence of MDM review. This could be because of poor documentation, or due to lack of infrastructure to facilitate MDM discussion. The MoH Draft Standards of Service Provision for CRC were published in December 2013. These contained the recommendation, for the first time, that all patients with colon or rectal cancer be discussed at a bowel cancer MDM. We expect that since the time of the PIPER cohort that the rates of MDM discussion will have increased significantly. We also noted whilst collecting data that systems for recording MDM discussion were highly variable between centres. Coordination of recording MDM outcomes may be one mechanism to improve documentation, and an electronic record of MDM outcomes would further facilitate data capture.

Highlights: non-metastatic colon cancer – Surgical Treatment

95% of patients with non-metastatic colon cancer underwent resection of their primary

Endoscopic resection only was undertaken in 2% of cases

Complete excision was reported for 81% of cases

Median length of post-operative stay was 9 days

6% of patients had an unplanned return to theatre

Evidence of anastomotic leak was documented in 4% of patients with an anastomosis

30 day post-operative mortality was 3%, and 90 day post-operative mortality was 5%

There was no evidence of MDM discussion for 69% of patients

4.6.2 Stage III colon cancer: adjuvant treatment

4.6.2.1 KPIs for the section adjuvant treatment for stage III colon cancer

The key performance indicators used for describing adjuvant treatment for colon cancer in this section are:

- Attended first specialist assessment (FSA) with Medical Oncology (MO)
- Offered adjuvant chemotherapy
- Regimen received
- Receipt of oral chemotherapy
- Uptake of oxaliplatin
- Stopping chemotherapy early
- Reason for stopping chemotherapy
- Completing at least 24 weeks of chemotherapy
- Receiving post-op RT

In the early 1990's clinical trial, evidence of the survival benefit of adding adjuvant chemotherapy for patients undergoing curative resection of colon cancer had matured, leading to recommendations that all patients with stage III colon cancer should routinely receive adjuvant chemotherapy.[57]

Regimens were initially based on a backbone of 5-fluoruracil (5FU) usually in combination with other cytotoxic agents and/or a variety of immune modulating drugs (e.g. levamisole & interferon). Further trial results consolidated the evidence around the preferred regimen of 5FU and folinic acid (Leucovorin)[58] and further studies determined that 6 months of therapy was the optimum duration.[59]

At the same time the speciality of Medical Oncology was getting established in NZ, with NZ trainees returning to fill posts in several of the non-surgical cancer health facilities which until then had focused largely on treatment of cancer with radiation. The Medical Oncology workforce steadily incorporated the international recommendations into clinical practice so that by 2007 it would have been considered routine for patients with stage III colon cancer to be considered for adjuvant chemotherapy and to be referred to a Medical Oncologist for a discussion about that treatment option.

The optimal chemotherapy regimen remained unchanged until 2004 when the results of 2 large randomised controlled trials reported improved patient outcomes with the addition of oxaliplatin to 5FU/Leucovorin regimens.[60] PHARMAC approved the funding of oxaliplatin for patients with stage III CRC on December 1, 2007 in the middle of the PIPER study period.

4.6.2.2 Cohort of patients with stage III colon cancer

There were 925 colon cancer patients in the main PIPER cohort who had resection of their primary, and who had stage III disease (for 10 patients their disease progressed within 8 weeks of the resection of their primary, and they are considered as stage IV disease for examining KPIs for chemotherapy).

Of the 915 patients, 32 died within 8 weeks of resection of the primary. None of the 32 had started chemotherapy, and they are included in all analyses unless otherwise specified.

Overall 59% of all people with stage III colon cancer were diagnosed at age 70 years or over. A lower proportion of rural patients were aged 70 or over (46%) compared with urban (60%) and independent urban (59%) patients.

In the cohort overall 52% of patients diagnosed with stage III colon cancer were women. Of patients diagnosed with stage III colon cancer who were resident in the rural setting, 41% were female compared to 54% diagnosed whilst resident in the urban setting and 49% diagnosed while resident in an independent urban setting. Overall 20% of patients diagnosed with stage III colon cancer had a comorbidity score of 2 or greater (higher levels indicate greater comorbidity). There are no clear differences in the comorbidity scores of patients based on the location of their residence.

Table 4.6-61 Age (in years) at diagnosis by rurality of residence at time of diagnosis for patients with stage III colon cancer

Age group at diagnosis	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	14	2.2	2	1.3	2	1.9	1	5.6	19	2.1
>40-50	28	4.4	3	1.9	5	4.7	2	11.1	38	4.2
>50-60	68	10.8	17	10.6	14	13.2	4	22.2	103	11.3
>60-70	142	22.5	43	26.9	36	34.0	7	38.9	228	24.9
>70-80	220	34.9	60	37.5	34	32.1	1	5.6	315	34.4
>/=80	159	25.2	35	21.9	15	14.2	3	16.7	212	23.2
Total	631	100.0	160	100.0	106	100.0	18	100.0	915	100.0

Table 4.6-62 Gender by rurality of residence at time of diagnosis for patients with stage III colon cancer

Gender	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	342	54.2	78	48.8	43	40.6	10	55.6	473	51.7
Male	289	45.8	82	51.3	63	59.4	8	44.4	442	48.3
Total	631	100.0	160	100.0	106	100.0	18	100.0	915	100.0

Table 4.6-63 C3 comorbidity score by rurality of residence at time of diagnosis for patients with stage III colon cancer

C3 comorbidity score*	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	294	46.6	70	43.8	54	50.9	14	77.8	432	47.2
>0<1	115	18.2	30	18.8	22	20.8	3	16.7	170	18.6
1<2	96	15.2	22	13.8	15	14.2	0	0	133	14.5
>2	126	20.0	38	23.8	15	14.2	1	5.6	180	19.7
Total	631	100.0	160	100.0	106	100.0	18	100.0	915	100.0

* higher scores indicate higher degree of comorbidity

There were no clear trends in the relationship between distance from residence at diagnosis to the health facility at which the diagnosis was made and age at diagnosis, although it is noted that 15% of patients 80 years and over with stage III colon cancer resided over 50km from the diagnostic facility compared to 23% of patients over 80 years overall.

Of those patients diagnosed with colon cancer in a facility within 5km of their residence, 60% were female; whereas of those diagnosed in a facility greater than 50kms from their residence 44% were female.

There were no clear trends in the distribution of patient comorbidity scores and the distance from diagnostic facility to the place of patient's residence.

Table 4.6-64 Age (in years) at diagnosis by distance of residence at time of diagnosis from the health facility where the diagnosis was made for patients with stage III colon cancer

Age group at diagnosis	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	7	2.2	4	2.1	2	1.5	2	1.3	3	2.9	1	5.3	19	2.1
>40-50	16	5.1	6	3.1	7	5.3	3	1.9	4	3.9	2	10.5	38	4.2
>50-60	34	10.8	18	9.3	13	9.8	16	10.4	18	17.6	4	21.1	103	11.3
>60-70	81	25.8	38	19.7	35	26.3	35	22.7	32	31.4	7	36.8	228	24.9
>70-80	97	30.9	73	37.8	47	35.3	66	42.9	30	29.4	2	10.5	315	34.4
>=80	79	25.2	54	28.0	29	21.8	32	20.8	15	14.7	3	15.8	212	23.2
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	19	100.0	915	100.0

Table 4.6-65 Gender by distance of residence at time of diagnosis from the health facility where the diagnosis was made for patients with stage III colon cancer

Gender	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Female	187	59.6	100	51.8	61	45.9	69	44.8	45	44.1	11	57.9	473	51.7
Male	127	40.4	93	48.2	72	54.1	85	55.2	57	55.9	8	42.1	442	48.3
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	19	100.0	915	100.0

Table 4.6-66 C3 comorbidity score by distance of residence at time of diagnosis from the health facility where the diagnosis was made for patients with stage III colon cancer

C3 comorbidity score	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
0	151	48.1	82	42.5	60	45.1	75	48.7	49	48.0	15	78.9	432	47.2
0-<1	64	20.4	34	17.6	23	17.3	31	20.1	15	14.7	3	15.8	170	18.6
1-<2	50	15.9	22	11.4	24	18.0	21	13.6	16	15.7	0	0	133	14.5
>2	49	15.6	55	28.5	26	19.5	27	17.5	22	21.6	1	5.3	180	19.7
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	19	100.0	915	100.0

There were no clear trends between age at diagnosis and the area deprivation score of the patient's residence at the time of diagnosis of stage III colon cancer. There were no clear associations between gender and area deprivation score of residence at diagnosis.

Fifty-five percent of patients with stage III colon cancer living in a low deprivation area (1-2) at time of diagnosis had a comorbidity score of 0 as compared to 38% of patients living in a high deprivation(9-10) area residence. Conversely 23% of patients living in high deprivation areas (9-10) had a comorbidity score over 2 compared to 16% in those in the low deprivation areas (1-2). These findings reflect the linkage between deprivation and comorbidity.

Table 4.6-67 Age (in years) at diagnosis by area deprivation score of place of residence at time of diagnosis for patients with stage III colon cancer

Age group at diagnosis	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	8	4.3	1	0.5	1	0.5	2	1.1	6	4.4	1	4.5	19	2.1
>40-50	6	3.2	13	6.9	9	4.5	4	2.2	4	3.0	2	9.1	38	4.2
>50-60	16	8.6	27	14.4	22	11.0	18	9.8	16	11.9	4	18.2	103	11.3
>60-70	62	33.2	41	21.8	41	20.5	52	28.4	25	18.5	7	31.8	228	24.9
>70-80	52	27.8	63	33.5	82	41.0	67	36.6	49	36.3	2	9.1	315	34.4
>=80	43	23.0	43	22.9	45	22.5	40	21.9	35	25.9	6	27.3	212	23.2
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	22	100.0	915	100.0

Table 4.6-68 Gender at diagnosis by area deprivation score of place of residence at time of diagnosis for patients with stage III colon cancer

Gender	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Female	86	46.0	105	55.9	99	49.5	99	54.1	72	53.3	12	54.5	473	51.7
Male	101	54.0	83	44.1	101	50.5	84	45.9	63	46.7	10	45.5	442	48.3
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	22	100.0	915	100.0

Table 4.6-69 C3 comorbidity score at diagnosis by area deprivation score of place of residence at time of diagnosis for patients with stage III colon cancer

C3 comorbidity score	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
0	102	54.5	92	48.9	81	40.5	91	49.7	51	37.8	15	68.2	432	47.2
>0-<1	39	20.9	34	18.1	41	20.5	26	14.2	27	20.0	3	13.6	170	18.6
1-<2	16	8.6	28	14.9	35	17.5	26	14.2	26	19.3	2	9.1	133	14.5
>2	30	16.0	34	18.1	43	21.5	40	21.9	31	23.0	2	9.1	180	19.7
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	22	100.0	915	100.0

In the extended PIPER cohort, including the years 2006-2009, there were 1021 patients with stage III colon cancer who had their primary tumour resected (excluding patients diagnosed with metastatic disease within 8 weeks of surgery).

Of those diagnosed with stage III colon cancer, the proportion of patients aged 70 years or over was 39% in Māori and 17% in Pacific compared with 59% in nMnP patients.

There were no major differences in gender distribution of stage III colon cancer patients in the Māori, Pacific and nMnP patients.

In this patient population there are no clear differences in comorbidity scores for Māori, Pacific and nMnP, however this may be related to differences in age distribution or small numbers, particularly for Pacific patients.

Table 4.6-70 Age (in years) at diagnosis by prioritised ethnicity for patients with stage III colon cancer

Age group at diagnosis	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	4	5.3	0	0	17	1.8	0	0	21	2.1
40-49	8	10.7	6	25.0	43	4.7	0	0	57	5.6
50-59	14	18.7	5	20.8	96	10.4	1	33.3	116	11.4
60-69	20	26.7	9	37.5	224	24.4	1	33.3	254	24.9
70-79	21	28.0	2	8.3	321	34.9	0	0	344	33.7
>=80	8	10.7	2	8.3	218	23.7	1	33.3	229	22.4
Total	75	100.0	24	100.0	919	100.0	3	100.0	1021	100.0

Table 4.6-71 Gender at diagnosis by prioritised ethnicity for patients with stage III colon cancer

Gender	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	38	50.7	11	45.8	472	51.4	1	33.3	522	51.1
Male	37	49.3	13	54.2	447	48.6	2	66.7	499	48.9
Total	75	100.0	24	100.0	919	100.0	3	100.0	1021	100.0

Table 4.6-72 C3 comorbidity score at diagnosis by prioritised ethnicity for patients with stage III colon cancer

C3 comorbidity score	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	30	40.0	9	37.5	436	47.4	1	33.3	476	46.6
0-<1	20	26.7	4	16.7	166	18.1	1	33.3	191	18.7
1-<2	9	12.0	8	33.3	131	14.3	0	0	148	14.5
>2	16	21.3	3	12.5	186	20.2	1	33.3	206	20.2
Total	75	100.0	24	100.0	919	100.0	3	100.0	1021	100.0

4.6.2.3 Rurality of residence at diagnosis for colon cancer

Of the 915 patients with stage III colon cancer in the 2007-2008 cohort, rurality of residence was unknown for 18, leaving 897 patients for these analyses. Over the timeframe of the follow-up in this report only a small number of patients died (32), so mortality does not impact significantly on the figures given below.

The overall proportion who attended a Medical Oncology specialist assessment was 77% (95% CI: 74 to 80) (Table 4.6-73). A greater proportion of patients diagnosed with stage III colon cancer from rural areas attended a Medical Oncology specialist assessment (83% compared with 77% and 37% in urban and independent urban areas respectively), although these differences were not statistically significant (p=0.2).

The proportion of patients with stage III colon cancer being offered chemotherapy was 67% overall (95% CI: 64 to 70), was higher among patients who resided in rural areas (79% compared with 63% for urban and 63% for independent urban areas); the difference was statistically significant (p=0.02) (Table 4.6-74). Overall 42% of patients with stage III colon cancer did not receive any adjuvant chemotherapy (95% CI: 38 to 45). The proportions varied by rurality, similarly to the proportion offered chemotherapy, from 29% for patients living in rural areas, to 43% for both urban and independent urban areas (p=0.007). However there were differences between rural and other regions in terms of age and gender distribution, which are likely to be influencing these comparisons. We have planned to carry out analyses adjusting for age, gender and other factors in our second phase of analysis.

Of those patients receiving chemotherapy, 35% received 5FU/capecitabine plus oxaliplatin whereas 65% received only 5FU or capecitabine (Table 4.6-75). There was no significant difference in the proportion receiving oxaliplatin by rurality (p=0.8).

Capecitabine is orally administered (on a 21-day cycle) and when given as a single agent does not need an infusion centre and requires only one clinic visit per cycle. 5FU however is administered intravenously (either on a weekly or fortnightly schedule) and often on a day separate to the medical assessment. Oxaliplatin is administered intravenously either every 21

or 14 days with capecitabine or 5FU, so either way capecitabine schedules require fewer clinic attendances for patients. The overall proportion receiving capecitabine was 61% (95% CI: 56 to 65) (Table 4.6-77). The proportion was higher for patients living in rural areas (70%) than urban (59%) or independent urban (58%) areas, but the difference was not statistically significant (p=0.2).

Oxaliplatin is effective given either with capecitabine or with 5FU; 16% of oxaliplatin use was with capecitabine and 5% with 5FU. Of the capecitabine-oxaliplatin combination this was used in 24% percent of rural patients and 14% of urban patients (Table 4.6-76).

The use of oxaliplatin as adjuvant therapy for stage III colon cancer was approved for funding by PHARMAC from December 1 2007, approximately half way through the 2007-2008 PIPER cohort. The overall impact of funding for oxaliplatin was not to increase the percentage of patients receiving adjuvant chemotherapy (7-12% per 6 month time period received no adjuvant therapy) but to increase the proportion of those having chemotherapy receiving oxaliplatin based combination chemotherapy. Of those patients with stage III colon cancer receiving adjuvant chemotherapy the percentages of patients receiving oxaliplatin-based treatment in the 4 sequential six-month cohorts were 10% (11/114), 18% (23/130), 57% (76/133) and 51% (76/148) respectively, indicating the implementation of the funding change was largely complete within 6 months of funding decision (Table 4.6-78). The relationship between in uptake and rurality of residence is more difficult to interpret although it does not appear that rurally based patients were less likely to get timely introduction of oxaliplatin (Table 4.6-79, Table 4.6-80).

Table 4.6-73 Attendance at Medical Oncology specialist assessment by rurality of residence at time of diagnosis for patients with stage III colon cancer

	Rurality of residence at time of diagnosis								
MO FSA attended	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	488	77.3	116	72.5	88	83.0	692	77.1	0.2
No	139	22.0	42	26.3	18	17.0	199	22.2	
Unknown	4	0.6	2	1.3	0	0	6	0.7	
Total	631	100.0	160	100.0	106	100.0	897	100.0	

Table 4.6-74 Chemotherapy offered by rurality of residence at time of diagnosis for patients with stage III colon cancer

Chemotherapy offered	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	417	66.1	101	63.1	84	79.2	602	67.1	0.02
No	209	33.1	57	35.6	22	20.8	288	32.1	
Unknown	5	0.8	2	1.3	0	0	7	0.8	
Total	631	100.0	160	100.0	106	100.0	897	100.0	

Table 4.6-75 Chemotherapy regimen by rurality of residence at time of diagnosis for patients with stage III colon cancer

Chemotherapy regimen	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
5FU/capecitabine + oxaliplatin	122	19.3	35	21.9	27	25.5	184	20.5	0.8
5FU/capecitabine	233	36.9	57	35.6	49	46.2	339	37.8	
Oxaliplatin	2	0.3	0	0	0	0	2	0.2	
None	274	43.4	68	42.5	30	28.3	372	41.5	
Total	631	100.0	160	100.0	106	100.0	897	100.0	

* p-value compares 5FU/capecitabine with or without oxaliplatin

Table 4.6-76 Chemotherapy detail by rurality of residence at time of diagnosis for patients with stage III colon cancer

Chemotherapy regimen	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Capecitabine alone	122	19.3	24	15.0	28	26.4	174	19.4
5FU alone	111	17.6	33	20.6	21	19.8	165	18.4
Capecitabine + oxaliplatin	90	14.3	29	18.1	25	23.6	144	16.1
5FU + oxaliplatin	32	5.1	6	3.8	2	1.9	40	4.5
Other	2	0.3	0	0	0	0	2	0.2
None	274	43.4	68	42.5	30	28.3	372	41.5
Total	631	100.0	160	100.0	106	100.0	897	100.0

Table 4.6-77 Use of capecitabine vs. 5FU by rurality of residence at time of diagnosis for patients with stage III colon cancer

Chemotherapy regimen	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural		Total	%	p-value
	N	%	N	%	N	%			
5FU	143	40.1	39	42.4	23	30.3	205	39.0	0.2
Capecitabine	212	59.4	53	57.6	53	69.7	318	60.6	
Other	2	0.6	0	0	0	0	2	0.4	
Total	357	100.0	92	100.0	76	100.0	525	100.0	

*p-value compares 5FU and capecitabine %, excludes the 2 others

Table 4.6-78 Oxaliplatin use by time period around PHARMAC approval for funding from December 1 2007diagnosis for patients with stage III colon cancer

Oxaliplatin use	Time period: 1 Jan 2007 - 31 May 2007		1 June 2007 - 31 Nov 2007		1 Dec 2007 - 31 May 2008		1 June 2008 - 31 Dec 2008		Total	%	p-value
	N	%	N	%	N	%	N	%			
Yes	11	9.6	23	17.7	76	57.1	76	51.4	186	35.4	<0.0001
No	103	90.4	107	82.3	57	42.9	72	48.6	339	64.6	
Total	114	100.0	130	100.0	133	100.0	148	100.0	525	100.0	

Table 4.6-79 Uptake of oxaliplatin by rurality of residence at time of diagnosis for all patients with stage III colon cancer

Oxaliplatin use		Rurality of residence at time of diagnosis							
		Urban		Independent urban		Rural			
		N	%	N	%	N	%	Total	%
Time period	**Oxaliplatin**								
1 Jan 2007 - 31 May 2007	**Yes**	9	6.7	1	4.2	1	5.3	11	1.2
	No	82	60.7	10	41.7	11	57.9	103	11.5
	No adjuvant therapy	44	32.6	13	54.2	7	36.8	64	7.1
	Total	135	100.0	24	100.0	19	100.0	178	19.8
1 June 2007 - 31 Nov 2007	**Oxaliplatin**								
	Yes	14	9.0	5	11.6	4	12.9	23	2.6
	No	68	43.9	20	46.5	19	61.3	107	11.9
	No adjuvant therapy	73	47.1	18	41.9	8	25.8	99	11.0
	Total	155	100.0	43	100.0	31	100.0	229	25.5
1 Dec 2007 - 31 May 2008	**Oxaliplatin**								
	Yes	43	26.7	16	36.4	17	50.0	76	8.5
	No	39	24.2	10	22.7	8	23.5	57	6.4
	No adjuvant therapy	79	49.1	18	40.9	9	26.5	106	11.8
	Total	161	100.0	44	100.0	34	100.0	239	26.6
1 June 2008 - 31 Dec 2008	**Oxaliplatin**								
	Yes	58	32.2	13	26.5	5	22.7	76	8.5
	No	44	24.4	17	34.7	11	50.0	72	8.0
	No adjuvant therapy	78	43.3	19	38.8	6	27.3	103	11.5
	Total	180	100.0	49	100.0	22	100.0	251	28.0
	Total	631	100.0	160	100.0	106	100.0	897	100.0

Table 4.6-80 Uptake of oxaliplatin by rurality of residence at time of diagnosis for the patients with stage III colon cancer who received adjuvant chemotherapy

Oxaliplatin use		Rurality of residence at time of diagnosis							
		Urban		Independent urban		Rural			
		N	%	N	%	N	%	Total	%
Time period	**Oxaliplatin**								
1 Jan 2007 - 31 May 2007	**Yes**	9	9.9	1	9.1	1	8.3	11	2.1
	No	82	90.1	10	90.9	11	91.7	103	19.6
	Total	91	100.0	11	100.0	12	100.0	114	21.7
1 June 2007 - 31 Nov 2007	**Oxaliplatin**								
	Yes	14	17.1	5	20.0	4	17.4	23	4.4
	No	68	82.9	20	80.0	19	82.6	107	20.4
	Total	82	100.0	25	100.0	23	100.0	130	24.8
1 Dec 2007 - 31 May 2008	**Oxaliplatin**								
	Yes	43	52.4	16	61.5	17	68.0	76	14.5
	No	39	47.6	10	38.5	8	32.0	57	10.9
	Total	82	100.0	26	100.0	25	100.0	133	25.3
1 June 2008 - 31 Dec 2008	**Oxaliplatin**								
	Yes	58	56.9	13	43.3	5	31.3	76	14.5
	No	44	43.1	17	56.7	11	68.8	72	13.7
	Total	102	100.0	30	100.0	16	100.0	148	28.2
	Total	357	100.0	92	100.0	76	100.0	525	100.0

An indicator of feasibility of treatment is the ability to complete the planned course of chemotherapy. We investigated the completion of the first planned course (i.e. first line) of chemotherapy. For the first course of chemotherapy, the overall proportion of patients who stopped chemotherapy early was 41% (95% CI: 37 to 45) (Table 4.6-81). While there were some small differences in the proportions by rurality they were not statistically significant (p=0.5).

The most frequent reason recorded for stopping chemotherapy was treatment toxicity (66%) with a smaller proportion of urban patients (60%) than independent urban (79%) and rural (73%) stopping for this reason (Table 4.6-82). In addition, (treatment-related) death (1%), patient request (10%), and change of (toxic) chemotherapy (4%) are also likely to be related to toxicity, giving a total of 82% of patients stopping treatment due to toxicity.

Another measure of adherence to the prescribed adjuvant chemotherapy program and surrogate for tolerance is the percentage of patients completing at least 24 weeks of chemotherapy, a duration considered to be standard of care based on current literature. The randomised controlled trial of adjuvant chemotherapy comparing 3 months vs. 6 months of capecitabine-oxaliplatin (the 'SCOT' Study) was not recruiting during this period. For this analysis the duration was calculated over all courses of chemotherapy that were part of their first treatment. We found only 43% of patients completed at least 24 weeks of chemotherapy (95% CI (38 to 47) (Table 4.6-83). However interpretation of this measure should be made with some caution because the patient's last date of intravenous treatment was recorded as the stop-date which therefore underestimates the duration of the last cycle by up to 3 weeks. The results of the SCOT study will better inform the significance of the findings. There are various factors that may be relevant to treatment of patients resident in the rural areas which need to be taken into consideration in further analyses and interpretation.

Table 4.6-81 Patients who stopped their first course of chemotherapy early by rurality of residence at time of diagnosis for patients with stage III colon cancer.

Stopped chemotherapy early	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	144	40.3	43	46.7	29	38.2	216	41.1	0.5
No	203	56.9	49	53.3	46	60.5	298	56.8	
Unknown	10	2.8	0	0	1	1.3	11	2.1	
Total	357	100.0	92	100.0	76	100.0	525	100.0	

Table 4.6-82 Reason for stopping chemotherapy earlier than planned by rurality of residence at time of diagnosis for patients with stage III colon cancer

Reason for stopping chemotherapy	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Toxicity	93	60.4	34	79.1	22	73.3	149	65.6
Unrelated adverse event, co-morbidity	8	5.2	3	7.0	0	0	11	4.8
Progression of cancer or recurrence	13	8.4	4	9.3	1	3.3	18	7.9
Death	2	1.3	0	0	1	3.3	3	1.3
Patient request	18	11.7	1	2.3	3	10.0	22	9.7
Change of chemotherapy	8	5.2	1	2.3	1	3.3	10	4.4
Other	2	1.3	0	0	1	3.3	3	1.3
Unknown	10	6.5	0	0	1	3.3	11	4.8
Total	154	100.0	43	100.0	30	100.0	227	100.0

Table 4.6-83 Patients who completed at least 24 weeks of chemotherapy by rurality of residence at time of diagnosis for patients with stage III colon cancer

Completed at least 24 weeks of chemotherapy	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	147	41.2	43	46.7	34	44.7	224	42.7	0.6
No	203	56.9	48	52.2	42	55.3	293	55.8	
Unknown	7	2.0	1	1.1	0	0	8	1.5	
Total	357	100.0	92	100.0	76	100.0	525	100.0	

Post-operative radiation has no routine indication in the adjuvant treatment of colon cancer, which is reflected in the very low incidence of its use. An R1 resection might prompt the consideration of adjuvant radiation treatment; the proportion of these among the PIPER colon cancer cohort is very small.

Table 4.6-84 Use of post-operative radiotherapy by rurality of residence at time of diagnosis for patients with stage III colon cancer

Post-operative radiotherapy	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Yes	11	1.7	3	1.9	1	0.9	15	1.7
No	620	98.3	157	98.1	105	99.1	882	98.3
Total	631	100.0	160	100.0	106	100.0	897	100.0

4.6.2.4 Distance of residence from the health facility of diagnosis for colon cancer

Of the 915 patients in the 2007 and 2008 cohort with stage III colon cancer (at 8 weeks after resection of the primary) distance from residence to facility of diagnosis was unknown for 19.

The was no clear variation in the proportions of patients having an assessment with Medical Oncology by distance from residence to the facility of diagnosis (p=0.3), suggesting ready access to the Medical Oncology clinic services for those living further away (Table 4.6-85).

As with rurality of residence, the proportion who were offered chemotherapy was not higher in those living further away (p=0.3), so distance from residence to facility of diagnosis does not immediately appear to adversely affect the likelihood of being offered chemotherapy (Table 4.6-86). However further investigation of the influence of any differences in age and gender is required.

A higher proportion of patients living over 50km from the facility of diagnosis received combination chemotherapy compared to those living closer (p=0.03). Of those receiving chemotherapy, the proportion on 5FU/capecitabine plus oxaliplatin was 50% for those living over 50km away compared with 27%-37% for those living closer (Table 4.6-87 and Table 4.6-88).

When considering adjuvant chemotherapy with either 5FU or capecitabine (alone or in combination with oxaliplatin), capecitabine is used in 65% of patients and 5FU in 35%. In the group living more than 50 km from the diagnostic facility the proportion using capecitabine (vs 5FU) was 72%, compared with 52-63% for those living closer (p=0.03) (Table 4.6-89). This is likely to reflect the convenience of less travel due to the reduced number of clinic visits required for the 3 weekly oxaliplatin-capecitabine combination. There did not appear to be a

difference by distance in uptake of oxaliplatin after funding was introduced (Table 4.6-90, Table 4.6-91).

There was no significant difference between the proportion stopping their first course of chemotherapy early by distance of residence from the diagnostic facility (Table 4.6-92). There are also no discernible differences in the reasons to discontinue chemotherapy (Table 4.6-93) or the proportion completing 24 weeks of chemotherapy by distance from residence to facility of diagnosis (Table 4.6-94).

Table 4.6-85 Attendance at Medical Oncology specialist assessment by distance from residence at diagnosis to health facility of diagnosis for patients with stage III colon cancer

	Distance from residence to facility of diagnosis												
MO FSA attended	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	231	73.6	148	76.7	111	83.5	118	76.6	83	81.4	691	77.1	0.3
No	80	25.5	43	22.3	22	16.5	35	22.7	19	18.6	199	22.2	
Unknown	3	1.0	2	1.0	0	0	1	0.6	0	0	6	0.7	
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	896	100.0	

Table 4.6-86 Chemotherapy offered by distance from residence at diagnosis to health facility of diagnosis for patients with stage III colon cancer

	Distance from residence to facility of diagnosis												
Chemotherapy offered	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	202	64.3	132	68.4	91	68.4	99	64.3	77	75.5	601	67.1	0.3
No	109	34.7	58	30.1	42	31.6	54	35.1	25	24.5	288	32.1	
Unknown	3	1.0	3	1.6	0	0	1	0.6	0	0	7	0.8	
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	896	100.0	

Table 4.6-87 Chemotherapy regimen by distance from residence at diagnosis to health facility of diagnosis for patients with stage III colon cancer

Chemotherapy regimen	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU/capecitabine + oxaliplatin	66	21.0	33	17.1	28	21.1	23	14.9	34	33.3	184	20.5	0.03*
5FU/capecitabine	113	36.0	77	39.9	51	38.3	63	40.9	34	33.3	338	37.7	
Oxaliplatin	1	0.3	1	0.5	0	0	0	0	0	0	2	0.2	
None	134	42.7	82	42.5	54	40.6	68	44.2	34	33.3	372	41.5	
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	896	100.0	

* p-value compares 5FU/capecitabine with or without oxaliplatin

Table 4.6-88 Chemotherapy regimen detail by distance from residence at diagnosis to health facility of diagnosis

Chemotherapy regimen	Distance from residence to facility of diagnosis											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Capecitabine alone	55	17.5	37	19.2	28	21.1	36	23.4	18	17.6	174	19.4
5FU alone	58	18.5	40	20.7	23	17.3	27	17.5	16	15.7	164	18.3
Capecitabine + oxaliplatin	54	17.2	21	10.9	20	15.0	18	11.7	31	30.4	144	16.1
5FU + oxaliplatin	12	3.8	12	6.2	8	6.0	5	3.2	3	2.9	40	4.5
Other	1	0.3	1	0.5	0	0	0	0	0	0	2	0.2
None	134	42.7	82	42.5	54	40.6	68	44.2	34	33.3	372	41.5
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	896	100.0

Table 4.6-89 Use of capecitabine vs. 5FU by distance from residence at diagnosis to health facility of diagnosis for patients with stage III colon cancer

Chemotherapy regimen	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU	70	38.9	52	46.8	31	39.2	32	37.2	19	27.9	204	38.9	0.03
Capecitabine	109	60.6	58	52.3	48	60.8	54	62.8	49	72.1	318	60.7	
Other	1	0.6	1	0.9	0	0	0	0	0	0	2	0.4	
Total	180	100.0	111	100.0	79	100.0	86	100.0	68	100.0	524	100.0	

Table 4.6-90 Uptake of oxaliplatin by distance from residence at diagnosis to health facility of diagnosis for stage III colon cancer patients

Oxaliplatin use		Distance from residence to facility of diagnosis											
		0-<5		5-<10		10-<20		20-<50		50>/=			
		N	%	N	%	N	%	N	%	N	%	Total	%
Time period	**Oxaliplatin**												
1 Jan 2007 - 31 May 2007	**Yes**	2	3.3	6	15.0	0	0	1	3.6	2	11.1	11	1.2
	No	34	55.7	22	55.0	20	64.5	18	64.3	9	50.0	103	11.5
	No adjuvant therapy	25	41.0	12	30.0	11	35.5	9	32.1	7	38.9	64	7.1
	Total	61	100.0	40	100.0	31	100.0	28	100.0	18	100.0	178	19.9
1 June 2007 - 31 Nov 2007	**Oxaliplatin**												
	Yes	6	7.1	3	6.7	4	14.3	4	8.9	6	22.2	23	2.6
	No	40	47.6	23	51.1	11	39.3	20	44.4	13	48.1	107	11.9
	No adjuvant therapy	38	45.2	19	42.2	13	46.4	21	46.7	8	29.6	99	11.0
	Total	84	100.0	45	100.0	28	100.0	45	100.0	27	100.0	229	25.6
1 Dec 2007 - 31 May 2008	**Oxaliplatin**												
	Yes	18	25.4	15	27.3	11	33.3	11	25.6	21	58.3	76	8.5
	No	19	26.8	11	20.0	8	24.2	12	27.9	6	16.7	56	6.3
	No adjuvant therapy	34	47.9	29	52.7	14	42.4	20	46.5	9	25.0	106	11.8
	Total	71	100.0	55	100.0	33	100.0	43	100.0	36	100.0	238	26.6
1 June 2008 - 31 Dec 2008	**Oxaliplatin**												
	Yes	41	41.8	10	18.9	13	31.7	7	18.4	5	23.8	76	8.5
	No	20	20.4	21	39.6	12	29.3	13	34.2	6	28.6	72	8.0
	No adjuvant therapy	37	37.8	22	41.5	16	39.0	18	47.4	10	47.6	103	11.5
	Total	98	100.0	53	100.0	41	100.0	38	100.0	21	100.0	251	28.0
	Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	896	100.0

Table 4.6-91 Uptake of oxaliplatin by distance from residence at diagnosis to health facility of diagnosis for all stage III colon cancer patients who received chemotherapy

Oxaliplatin use		Distance from residence to facility of diagnosis											
		0-<5		5-<10		10-<20		20-<50		50>/=			
		N	%	N	%	N	%	N	%	N	%	Total	%
Time period	**Oxaliplatin**												
1 Jan 2007 - 31 May 2007	**Yes**	2	5.6	6	21.4	0	0	1	5.3	2	18.2	11	2.1
	No	34	94.4	22	78.6	20	100.0	18	94.7	9	81.8	103	19.7
	Total	36	100.0	28	100.0	20	100.0	19	100.0	11	100.0	114	21.8
1 June 2007 - 31 Nov 2007	**Oxaliplatin**												
	Yes	6	13.0	3	11.5	4	26.7	4	16.7	6	31.6	23	4.4
	No	40	87.0	23	88.5	11	73.3	20	83.3	13	68.4	107	20.4
	Total	46	100.0	26	100.0	15	100.0	24	100.0	19	100.0	130	24.8
1 Dec 2007 - 31 May 2008	**Oxaliplatin**												
	Yes	18	48.6	15	57.7	11	57.9	11	47.8	21	77.8	76	14.5
	No	19	51.4	11	42.3	8	42.1	12	52.2	6	22.2	56	10.7
	Total	37	100.0	26	100.0	19	100.0	23	100.0	27	100.0	132	25.2
1 June 2008 - 31 Dec 2008	**Oxaliplatin**												
	Yes	41	67.2	10	32.3	13	52.0	7	35.0	5	45.5	76	14.5
	No	20	32.8	21	67.7	12	48.0	13	65.0	6	54.5	72	13.7
	Total	61	100.0	31	100.0	25	100.0	20	100.0	11	100.0	148	28.2
	Total	180	100.0	111	100.0	79	100.0	86	100.0	68	100.0	524	100.0

Table 4.6-92 Patients who stopped first chemotherapy regimen early by distance from residence at diagnosis to health facility of diagnosis for all patients who received chemotherapy for patients with stage III colon cancer

Stopped chemotherapy early	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	82	45.6	45	40.5	28	35.4	37	43.0	23	33.8	215	41.0	0.4
No	93	51.7	63	56.8	50	63.3	49	57.0	43	63.2	298	56.9	
Unknown	5	2.8	3	2.7	1	1.3	0	0	2	2.9	11	2.1	
Total	180	100.0	111	100.0	79	100.0	86	100.0	68	100.0	524	100.0	

Table 4.6-93 Reason for stopping chemotherapy early by distance from residence at diagnosis to health facility of diagnosis for all patients who received chemotherapy for patients with stage III colon cancer

Reason for stopping chemotherapy	Distance from residence to facility of diagnosis											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Toxicity	57	65.5	30	62.5	20	69.0	25	67.6	17	68.0	149	65.9
Unrelated adverse event, co-morbidity	6	6.9	1	2.1	1	3.4	2	5.4	1	4.0	11	4.9
Progression of cancer or recurrence	3	3.4	6	12.5	2	6.9	5	13.5	1	4.0	17	7.5
Death	0	0	1	2.1	0	0	1	2.7	1	4.0	3	1.3
Patient request	8	9.2	7	14.6	2	6.9	3	8.1	2	8.0	22	9.7
Change of chemotherapy	6	6.9	0	0	2	6.9	1	2.7	1	4.0	10	4.4
Other	2	2.3	0	0	1	3.4	0	0	0	0	3	1.3
Unknown	5	5.7	3	6.3	1	3.4	0	0	2	8.0	11	4.9
Total	87	100.0	48	100.0	29	100.0	37	100.0	25	100.0	226	100.0

Table 4.6-94 Patients who completed at least 24 weeks of chemotherapy by distance from residence at diagnosis to health facility of diagnosis for all patients who received chemotherapy for patients with stage III colon cancer

Completed at least 24 weeks of chemotherapy	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	81	45.0	41	36.9	32	40.5	39	45.3	31	45.6	224	42.7	0.1
No	98	54.4	68	61.3	47	59.5	43	50.0	36	52.9	292	55.7	
Unknown	1	0.6	2	1.8	0	0	4	4.7	1	1.5	8	1.5	
Total	180	100.0	111	100.0	79	100.0	86	100.0	68	100.0	524	100.0	

Table 4.6-95 Use of post-operative radiotherapy by distance from residence at diagnosis to health facility of diagnosis for all patients who received chemotherapy for patients with stage III colon cancer

Post-operative radiotherapy	Distance from residence to facility of diagnosis											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	7	2.2	4	2.1	0	0	2	1.3	2	2.0	15	1.7
No	307	97.8	189	97.9	133	100.0	152	98.7	100	98.0	881	98.3
Total	314	100.0	193	100.0	133	100.0	154	100.0	102	100.0	896	100.0

4.6.2.5 Area deprivation of residence at diagnosis for colon cancer

Of the 915 patients in the 2007 and 2008 cohort with stage III colon cancer (at 8 weeks after resection of the primary) distance from residence to facility of diagnosis was unknown for 22, leaving 893 patients for the analyses in this section.

There was no association between assessment by Medical Oncology and deprivation (p=0.7) (Table 4.6-96). Although there is no significant trend across the deprivation quintiles, chemotherapy was offered to 72% in low deprivation scores (1-2) and 62% in high deprivation scores (9-10) (p=0.3) (Table 4.6-97).

Adjuvant chemotherapy was not administered in 36% of patients from areas with low deprivation and in 49% of those from areas of high deprivation (9-10) (overall p=0.2) (Table 4.6-98, Table 4.6-99). Whilst there were no differences in use of single agent 5FU/capecitabine by deprivation quintile (low 36% and high 37% respectively), combination chemotherapy for stage III colon cancer was administered to fewer patients (14%) from areas of high deprivation (9-10) than patients from areas of low deprivation (1-2) (28%) (p=0.03). Interpretation will require further analyses, however the frequency of comorbidities related to deprivation is a likely to be influential here.

The use of capecitabine as a single agent or in combination with oxaliplatin was more frequent in patients from areas of high deprivation (9-10) (73% vs. 56% for areas of low deprivation (1-2)), although this difference was not statistically significant (p=0.2) (Table 4.6-100).

There did appear to be a difference in the uptake of oxaliplatin chemotherapy, although numbers are relatively small (Table 4.6-101, Table 4.6-102). Among those who received chemotherapy, use of oxaliplatin chemotherapy in patients from areas of low deprivation (1-2) patients before Dec 2007 was 21%, and increased to 64% after December 2007. In high deprivation area (9-10) the respective figures were 9% before and 47% after Dec 2007, suggesting a lower uptake of adjuvant oxaliplatin combination chemotherapy. More sophisticated analysis of these associations will be carried out in the second phase of analysis.

Early cessation of the first course of chemotherapy was more likely to occur in patients residing in areas of low deprivation (9-10) (28% vs. 34% in quintile (1-2), and 46-47% for the middle quintiles (p=0.02) (Table 4.6-103). This may be partially attributable to the fact that we have, at this stage, included only the first chemotherapy regimen the patients were on, so if patients drop oxaliplatin while continuing on 5FU/capecitabine this was counted as early cessation. There were fewer patients on oxaliplatin in the areas of low deprivation (1-2). Future planned analyses will examine patterns of use across all regimens of chemotherapy in each patient. The reasons for stopping early in patients from high deprivation areas may have been less related to chemotherapy toxicity (fewer on oxaliplatin) but more to do with unrelated co-morbidity, although there are also a few more unknowns in this group (Table 4.6-104).

The overall duration of the chemotherapy in the initial treatment (including all regimens) suggests that chemotherapy is completed equally across the deprivation quintiles (Table 4.6-105).

Table 4.6-96 Attendance at Medical Oncology specialist assessment by area deprivation of residence at diagnosis for patients with stage III colon cancer

MO FSA attended	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	144	77.0	146	77.7	159	79.5	142	77.6	99	73.3	690	77.3	0.7
No	41	21.9	41	21.8	40	20.0	39	21.3	36	26.7	197	22.1	
Unknown	2	1.1	1	0.5	1	0.5	2	1.1	0	0	6	0.7	
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	893	100.0	

Table 4.6-97 Patients offered chemotherapy by area deprivation of residence at diagnosis for patients with stage III colon cancer

Chemotherapy offered	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	135	72.2	127	67.6	136	68.0	120	65.6	83	61.5	601	67.3	0.3
No	50	26.7	59	31.4	63	31.5	61	33.3	52	38.5	285	31.9	
Unknown	2	1.1	2	1.1	1	0.5	2	1.1	0	0	7	0.8	
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	893	100.0	

Table 4.6-98 Chemotherapy regimen by area deprivation of residence at diagnosis for patients with stage III colon cancer.

Chemotherapy regimen	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU/capecitabine + oxaliplatin	53	28.3	42	22.3	43	21.5	27	14.8	19	14.1	184	20.6	0.03*
5FU/capecitabine	67	35.8	68	36.2	75	37.5	78	42.6	50	37.0	338	37.8	
Oxaliplatin	0	0	1	0.5	1	0.5	0	0	0	0	2	0.2	
None	67	35.8	77	41.0	81	40.5	78	42.6	66	48.9	369	41.3	
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	893	100.0	

*p-value compares 5FU/capecitabine with or without oxaliplatin

Table 4.6-99 Chemotherapy regimen detail by area deprivation of residence at diagnosis for patients with stage III colon cancer.

Chemotherapy regimen	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Capecitabine alone	35	18.7	40	21.3	41	20.5	33	18.0	25	18.5	174	19.5
5FU alone	32	17.1	28	14.9	34	17.0	45	24.6	25	18.5	164	18.4
Capecitabine + oxaliplatin	45	24.1	32	17.0	31	15.5	22	12.0	14	10.4	144	16.1
5FU + oxaliplatin	8	4.3	10	5.3	12	6.0	5	2.7	5	3.7	40	4.5
Other	0	0	1	0.5	1	0.5	0	0	0	0	2	0.2
None	67	35.8	77	41.0	81	40.5	78	42.6	66	48.9	369	41.3
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	893	100.0

Table 4.6-100 Use of capecitabine vs. 5FU by area deprivation of residence at diagnosis for patients with stage III colon cancer

Chemotherapy regimen	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU	40	33.3	38	34.2	46	38.7	50	47.6	30	43.5	204	38.9	0.2
Capecitabine	80	66.7	72	64.9	72	60.5	55	52.4	39	56.5	318	60.7	
Other	0	0	1	0.9	1	0.8	0	0	0	0	2	0.4	
Total	120	100.0	111	100.0	119	100.0	105	100.0	69	100.0	524	100.0	

Table 4.6-101 Uptake of oxaliplatin by area deprivation of residence at diagnosis for stage III colon cancer patients

Oxaliplatin use		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
period	Oxaliplatin												
1 Jan 2007 - 31 May 2007	Yes	5	12.2	3	7.9	2	5.7	1	2.9	0	0	11	1.2
	No	22	53.7	22	57.9	18	51.4	23	67.6	18	62.1	103	11.5
	No adjuvant therapy	14	34.1	13	34.2	15	42.9	10	29.4	11	37.9	63	7.1
	Total	41	100.0	38	100.0	35	100.0	34	100.0	29	100.0	177	19.8
1 June 2007 - 31 Nov 2007	Oxaliplatin												
	Yes	7	14.6	4	9.1	4	7.5	5	10.6	3	8.6	23	2.6
	No	22	45.8	21	47.7	24	45.3	25	53.2	14	40.0	106	11.9
	No adjuvant therapy	19	39.6	19	43.2	25	47.2	17	36.2	18	51.4	98	11.0
	Total	48	100.0	44	100.0	53	100.0	47	100.0	35	100.0	227	25.4
1 Dec 2007 - 31 May 2008	Oxaliplatin												
	Yes	21	46.7	15	30.6	20	35.7	13	24.1	7	20.0	76	8.5
	No	7	15.6	14	28.6	11	19.6	16	29.6	9	25.7	57	6.4
	No adjuvant therapy	17	37.8	20	40.8	25	44.6	25	46.3	19	54.3	106	11.9
	Total	45	100.0	49	100.0	56	100.0	54	100.0	35	100.0	239	26.8
1 June 2008 - 31 Dec 2008	Oxaliplatin												
	Yes	20	37.7	21	36.8	18	32.1	8	16.7	9	25.0	76	8.5
	No	16	30.2	11	19.3	22	39.3	14	29.2	9	25.0	72	8.1
	No adjuvant therapy	17	32.1	25	43.9	16	28.6	26	54.2	18	50.0	102	11.4
	Total	53	100.0	57	100.0	56	100.0	48	100.0	36	100.0	250	28.0

Table 4.6-102 Uptake of oxaliplatin by area deprivation of residence at diagnosis for all patients on adjuvant therapy

Oxaliplatin use		NZ Deprivation Index of residence at time of diagnosis 1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
period	**Oxaliplatin**												
1 Jan 2007 - 31 May 2007	**Yes**	5	18.5	3	12.0	2	10.0	1	4.2	0	0	11	2.1
	No	22	81.5	22	88.0	18	90.0	23	95.8	18	100.0	103	19.7
	Total	27	100.0	25	100.0	20	100.0	24	100.0	18	100.0	114	21.8
1 June 2007 - 31 Nov 2007	**Oxaliplatin**												
	Yes	7	24.1	4	16.0	4	14.3	5	16.7	3	17.6	23	4.4
	No	22	75.9	21	84.0	24	85.7	25	83.3	14	82.4	106	20.2
	Total	29	100.0	25	100.0	28	100.0	30	100.0	17	100.0	129	24.6
1 Dec 2007 - 31 May 2008	**Oxaliplatin**												
	Yes	21	75.0	15	51.7	20	64.5	13	44.8	7	43.8	76	14.5
	No	7	25.0	14	48.3	11	35.5	16	55.2	9	56.3	57	10.9
	Total	28	100.0	29	100.0	31	100.0	29	100.0	16	100.0	133	25.4
1 June 2008 - 31 Dec 2008	**Oxaliplatin**												
	Yes	20	55.6	21	65.6	18	45.0	8	36.4	9	50.0	76	14.5
	No	16	44.4	11	34.4	22	55.0	14	63.6	9	50.0	72	13.7
	Total	36	100.0	32	100.0	40	100.0	22	100.0	18	100.0	148	28.2
	Total	120	100.0	111	100.0	119	100.0	105	100.0	69	100.0	524	100.0

Table 4.6-103 Patients who stopped first course of chemotherapy early by area deprivation of residence at diagnosis for patients with stage III colon cancer

Stopped chemotherapy early	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	41	34.2	52	46.8	55	46.2	48	45.7	19	27.5	215	41.0	0.02
No	78	65.0	58	52.3	64	53.8	51	48.6	47	68.1	298	56.9	
Unknown	1	0.8	1	0.9	0	0	6	5.7	3	4.3	11	2.1	
Total	120	100.0	111	100.0	119	100.0	105	100.0	69	100.0	524	100.0	

Table 4.6-104 Reason for stopping first course of chemotherapy early by area deprivation of residence at diagnosis for patients with stage III colon cancer

Reason for stopping chemotherapy	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Toxicity	29	69.0	34	64.2	42	76.4	32	59.3	12	54.5	149	65.9
Unrelated adverse event, co-morbidity	0	0	2	3.8	1	1.8	6	11.1	2	9.1	11	4.9
Progression of cancer or recurrence	4	9.5	5	9.4	4	7.3	3	5.6	2	9.1	18	8.0
Death	0	0	0	0	2	3.6	1	1.9	0	0	3	1.3
Patient request	7	16.7	5	9.4	2	3.6	5	9.3	2	9.1	21	9.3
Change of chemotherapy	1	2.4	5	9.4	3	5.5	0	0	1	4.5	10	4.4
Other	0	0	1	1.9	1	1.8	1	1.9	0	0	3	1.3
Unknown	1	2.4	1	1.9	0	0	6	11.1	3	13.6	11	4.9
Total	42	100.0	53	100.0	55	100.0	54	100.0	22	100.0	226	100.0

Table 4.6-105 Patients who completed at least 24 weeks of chemotherapy by area deprivation of residence at diagnosis for patients with stage III colon cancer

Completed at least 24 weeks of chemotherapy	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	59	49.2	44	39.6	48	40.3	42	40.0	30	43.5	223	42.6	0.6
No	61	50.8	66	59.5	68	57.1	60	57.1	38	55.1	293	55.9	
Unknown	0	0	1	0.9	3	2.5	3	2.9	1	1.4	8	1.5	
Total	120	100.0	111	100.0	119	100.0	105	100.0	69	100.0	524	100.0	

Table 4.6-106 Use of post-operative radiotherapy by area deprivation of residence at diagnosis for patients with stage III colon cancer

Post-operative radiotherapy	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	5	2.7	1	0.5	3	1.5	2	1.1	4	3.0	15	1.7
No	182	97.3	187	99.5	197	98.5	181	98.9	131	97.0	878	98.3
Total	187	100.0	188	100.0	200	100.0	183	100.0	135	100.0	893	100.0

4.6.2.6 Ethnicity for colon cancer

Of the 1021 patients with stage III colon cancer in the extended PIPER cohort (diagnosed between 2006 and 2009), ethnicity was unknown for 3, leaving 1018 for analysis in this section. In this subgroup the numbers of Māori patients and Pacific patients are still small even with the extended cohort (75 and 24 respectively) so the subgroup estimates lack precision.

The proportion of patients offered adjuvant therapy were 69% for Māori, 88% Pacific and 67% nMnP, however these differences were not statistically significant (p=0.1) (Table 4.6-108). Further planned analyses will explore the role of confounding by age, gender and comorbidity as well as by clinical and disease characteristics as far as numbers allow.

The proportions of patients who did not receive any chemotherapy were 39% for Māori, 33% Pacific and 41% nMnP patient groups (Table 4.6-109). This was also not statistically significant (p=0.7). The proportion of Māori patients who received combination therapy (rather than single agent therapy) was smaller than that for Pacific or nMnP (17% vs. 29% and 21% respectively), although again the numbers are small (p=0.5) and we have not taken into account any differences in the characteristics of the patients in the three groups.

Of those who received adjuvant chemotherapy, the proportion on 5FU was higher for the Māori patient group (63%) than Pacific (38%) or nMnP (39%) (p=0.006) (Table 4.6-111). Māori seemed to be administered 5FU more often (35%) than capecitabine (9%) as a single agent compared to Pacific people and nMnP (Table 4.6-110).

For the group of Māori patients, use of oxaliplatin combination chemotherapy rose from 4% (1/27) to 36% (12/38) before and after special authority funding started in December 2007. For Pacific patients the use of oxaliplatin combination chemotherapy increased from zero (0/7) to 41% (7/17) and for nMnP increased from 9% (36/418) to 32% (159/501) (Table 4.6-112). If we look just at the use of oxaliplatin amongst those receiving chemotherapy, we find for Māori patients, use of oxaliplatin combination chemotherapy increased from 4% (1/25) to 57% (12/21) before and after special authority funding started in December 2007.For Pacific patients the use of oxaliplatin combination chemotherapy increased from zero (0/3) to 54% (7/13) and for nMnP increased from 14% (36/252) to 55% (159/287) (Table 4.6-113).

The proportions of patients who stopped their first course of adjuvant therapy early were 37% Māori; 25% PI and 42% nMnP (Table 4.6-114).

The reason for stopping chemotherapy in Māori was less often for toxicity (32% vs. 60% Pacific people and 65% nMnP) and more often unrelated comorbidity (11% vs. 0% for Pacific patients and 6% for nMnP) and patient request (16% vs. 0% for Pacific patients and 10% nMnP) (Table 4.6-115).

There was no association between not completing chemotherapy of 24 weeks duration and ethnicity however this will potentially be affected by factors such as the percentage having combination chemotherapy (Table 4.6-116).

Table 4.6-107 Attendance at Medical Oncology specialist assessment by prioritised ethnicity for patients with stage III colon cancer

MO FSA attended	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	53	70.7	22	91.7	705	76.7	780	76.6	0.1
No	21	28.0	2	8.3	203	22.1	226	22.2	
Unknown	1	1.3	0	0	11	1.2	12	1.2	
Total	75	100.0	24	100.0	919	100.0	1018	100.0	

Table 4.6-108 Patients offered chemotherapy by prioritised ethnicity for patients with stage III colon cancer

Chemotherapy offered	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	52	69.3	21	87.5	612	66.6	685	67.3	0.1
No	22	29.3	3	12.5	294	32.0	319	31.3	
Unknown	1	1.3	0	0	13	1.4	14	1.4	
Total	75	100.0	24	100.0	919	100.0	1018	100.0	

Table 4.6-109 Chemotherapy regimen by prioritised ethnicity for patients with stage III colon cancer

Chemotherapy regimen	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
5FU/capecitabine + oxaliplatin	13	17.3	7	29.2	192	20.9	212	20.8	0.5*
5FU/capecitabine	33	44.0	9	37.5	344	37.4	386	37.9	
Oxaliplatin	0	0	0	0	3	0.3	3	0.3	
None	29	38.7	8	33.3	380	41.3	417	41.0	
Total	75	100.0	24	100.0	919	100.0	1018	100.0	

*p-value compares 5FU/capecitabine with or without oxaliplatin

Table 4.6-110 Chemotherapy regimen detail by prioritised ethnicity for patients with stage III colon cancer

Chemotherapy regimen	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Capecitabine alone	7	9.3	5	20.8	182	19.8	194	19.1
5FU alone	26	34.7	4	16.7	162	17.6	192	18.9
Capecitabine + oxaliplatin	10	13.3	5	20.8	146	15.9	161	15.8
5FU + oxaliplatin	3	4.0	2	8.3	46	5.0	51	5.0
Other	0	0	0	0	3	0.3	3	0.3
None	29	38.7	8	33.3	380	41.3	417	41.0
Total	75	100.0	24	100.0	919	100.0	1018	100.0

Table 4.6-111 Use of capecitabine vs. 5FU by prioritised ethnicity for patients with stage III colon cancer

Chemotherapy regimen	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
5FU	29	63.0	6	37.5	208	38.6	243	40.4	0.006
Capecitabine	17	37.0	10	62.5	328	60.9	355	59.1	
Other	0	0	0	0	3	0.6	3	0.5	
Total	46	100.0	16	100.0	539	100.0	601	100.0	

Table 4.6-112 Uptake of oxaliplatin by prioritised ethnicity for stage I-III colon cancer patients

Oxaliplatin use		Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
period	Oxaliplatin								
1 Jan 2007 - 31 May 2007	Yes	1	4.0	0	0	14	7.1	15	1.5
	No	18	72.0	3	42.9	114	57.6	135	13.3
	No adjuvant therapy	6	24.0	4	57.1	70	35.4	80	7.9
	Total	25	100.0	7	100.0	198	100.0	230	22.6
1 June 2007 - 31 Nov 2007	Oxaliplatin								
	Yes	0	0	0	0	22	10.0	22	2.2
	No	6	50.0	0	0	102	46.4	108	10.6
	No adjuvant therapy	6	50.0	0	0	96	43.6	102	10.0
	Total	12	100.0	0	0	220	100.0	232	22.8
1 Dec 2007 - 31 May 2008	Oxaliplatin								
	Yes	2	18.2	2	33.3	74	32.6	78	7.7
	No	3	27.3	3	50.0	52	22.9	58	5.7
	No adjuvant therapy	6	54.5	1	16.7	101	44.5	108	10.6
	Total	11	100.0	6	100.0	227	100.0	244	24.0
1 June 2008 - 31 Dec 2008	Oxaliplatin								
	Yes	1	12.5	2	50.0	75	31.0	78	7.7
	No	3	37.5	1	25.0	68	28.1	72	7.1
	No adjuvant therapy	4	50.0	1	25.0	99	40.9	104	10.2
	Total	8	100.0	4	100.0	242	100.0	254	25.0
1 Jan 2009 - 31 Dec 2009	Oxaliplatin								
	Yes	9	47.4	3	42.9	10	31.3	22	2.2
	No	3	15.8	2	28.6	8	25.0	13	1.3
	No adjuvant therapy	7	36.8	2	28.6	14	43.8	23	2.3
	Total	19	100.0	7	100.0	32	100.0	58	5.7
	Total	75	100.0	24	100.0	919	100.0	1018	100.0

Table 4.6-113 Uptake of oxaliplatin by prioritised ethnicity for patients with stage III colon cancer who received chemotherapy

Oxaliplatin use		Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
period	**Oxaliplatin**								
1 Jan 2007 - 31 May 2007	**Yes**	1	5.3	0	0	14	10.9	15	2.5
	No	18	94.7	3	100.0	114	89.1	135	22.5
	Total	19	100.0	3	100.0	128	100.0	150	25.0
1 June 2007 - 31 Nov 2007	**Oxaliplatin**								
	Yes	0	0	0	0	22	17.7	22	3.7
	No	6	100.0	0	0	102	82.3	108	18.0
	Total	6	100.0	0	0	124	100.0	130	21.6
1 Dec 2007 - 31 May 2008	**Oxaliplatin**								
	Yes	2	40.0	2	40.0	74	58.7	78	13.0
	No	3	60.0	3	60.0	52	41.3	58	9.7
	Total	5	100.0	5	100.0	126	100.0	136	22.6
1 June 2008 - 31 Dec 2008	**Oxaliplatin**								
	Yes	1	25.0	2	66.7	75	52.4	78	13.0
	No	3	75.0	1	33.3	68	47.6	72	12.0
	Total	4	100.0	3	100.0	143	100.0	150	25.0
1 Jan 2009 - 31 Dec 2009	**Oxaliplatin**								
	Yes	9	75.0	3	60.0	10	55.6	22	3.7
	No	3	25.0	2	40.0	8	44.4	13	2.2
	Total	12	100.0	5	100.0	18	100.0	35	5.8
	Total	46	100.0	16	100.0	539	100.0	601	100.0

Table 4.6-114 Patients who stopped first course of chemotherapy early by prioritised ethnicity for patients with stage III colon cancer

Stopped chemotherapy early	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	17	37.0	4	25.0	224	41.6	245	40.8	0.4
No	27	58.7	11	68.8	305	56.6	343	57.1	
Unknown	2	4.3	1	6.3	10	1.9	13	2.2	
Total	46	100.0	16	100.0	539	100.0	601	100.0	

Table 4.6-115 Reason for stopping first course of chemotherapy early by prioritised ethnicity for patients with stage III colon cancer

Reason for stopping chemotherapy	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Toxicity	6	31.6	3	60.0	152	65.0	161	62.4
Unrelated adverse event, co-morbidity	2	10.5	0	0	14	6.0	16	6.2
Progression of cancer or recurrence	2	10.5	1	20.0	20	8.5	23	8.9
Death	1	5.3	0	0	3	1.3	4	1.6
Patient request	3	15.8	0	0	23	9.8	26	10.1
Change of chemotherapy	2	10.5	0	0	9	3.8	11	4.3
Other	1	5.3	0	0	3	1.3	4	1.6
Unknown	2	10.5	1	20.0	10	4.3	13	5.0
Total	19	100.0	5	100.0	234	100.0	258	100.0

Table 4.6-116 Patients who completed at least 24 weeks of chemotherapy by prioritised ethnicity for patients with stage III colon cancer

Completed at least 24 weeks of chemotherapy	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	17	37.0	6	37.5	221	41.0	244	40.6	0.8
No	29	63.0	10	62.5	308	57.1	347	57.7	
Unknown	0	0	0	0	10	1.9	10	1.7	
Total	46	100.0	16	100.0	539	100.0	601	100.0	

Table 4.6-117 Post-operative radiotherapy by prioritised ethnicity for patients with stage III colon cancer

Post-operative radiotherapy	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Yes	2	2.7	0	0	14	1.5	16	1.6
No	73	97.3	24	100.0	905	98.5	1002	98.4
Total	75	100.0	24	100.0	919	100.0	1018	100.0

4.6.2.7 Key points: adjuvant treatment for stage III colon cancer

Characteristics of stage III colon cancer patients:

- 60% of urban patients were aged 70 and over compared with only 46% of rural patients
- 59% of the non-Māori/non-Pacific patients were aged 70 or over compared with only 39% of Māori and 17% of Pacific

Medical Oncology (MO) First Specialist Assessment (FSA):

- Overall, similar proportions of patients had an FSA with MO across groups based on rurality, distance to health facility of diagnosis, and deprivation status (variation 73-84%). The high overall proportion of rural patients attending a MO FSA (84%) suggests that rural populations are not being under-serviced by medical oncology services. However the current analysis will not identify any differences that may be occurring by age group.
- There was greater variation between ethnic groups (Māori 71%, Pacific 92% and nMnP 77%). Provisional unadjusted analyses do not demonstrate a significant difference (p=0.1), however further detailed analysis will be performed to explore

confounding by age and comorbidity.

Offered Chemotherapy:

- A greater proportion of rural patients (79%) were offered adjuvant chemotherapy compared with their urban (66%) & independent urban (63%) counterparts. Although statistically significant (p = 0.02) this could be due to differences in age, gender and co-morbidity.
- Similar proportions of patients were offered chemotherapy between deprivation groups (62-72%). There was greater variation between ethnicity groups (Māori 69%, Pacific 88%, and nMnP 67%). Provisional un-adjusted analyses do not demonstrate a difference in the proportion offered chemotherapy based on deprivation (p = 0.3) or ethnicity (p=0.1). However, detailed analysis will be performed to explore the effects of confounding and the correlations between ethnicity, rurality, deprivation and distance.

Receiving Chemotherapy:

- In NZ during 2007 and 2008 only 59% of patients with stage III colon cancer who had undergone resection of primary disease received adjuvant chemotherapy.
- Oxaliplatin usage increased significantly during the study period consistent with the PHARMAC decision to fund oxaliplatin from December 1, 2007.
- The unadjusted proportions of patients receiving adjuvant chemotherapy were similar between groups of urban and independent urban residence, and higher for rural patients (57%, 58% and 72% respectively).
- A higher proportion of patients living over 50 km from a health facility of diagnosis received chemotherapy than those living closer. This result was statistically significant (p= 0.03) however, given the younger age structure of the rural population, age may be a confounding factor that needs exploring in further analyses.
- A higher proportion of patients living over 50 km from a health facility of diagnosis received oral capecitabine vs. IV 5FU (72% vs. 63% for those living closer (p=0.03).
- A higher proportion of patients living over 50km received combination therapy vs. single agent therapy compared with those living closer.

Stopping Chemotherapy Early:

- The highest deprivation score group (NZ Dep score 9-10) had the smallest proportion stopping chemotherapy early. The differences were statistically significant (p = 0.02). However this group have the smallest proportion receiving combination chemotherapy. There may also be differences in age, gender and co-morbidity profiles of the deprivation status groups.
- A similar proportion of patients stopped chemotherapy early across groups defined by rurality and distance to health facility of diagnosis (34-47%). There was greater variation between ethnic groups (Māori 37%, Pacific 25% and nMnP 42%). Provisional un-adjusted analyses do not demonstrate a significant difference (p=0.4), however further analyses will be performed to evaluate the role of the

demographic and clinical characteristics of the groups.

Completing at least 24 weeks chemotherapy:

- Overall fewer than 55% of patients who received adjuvant therapy for stage III colon cancer completed at least 24 weeks of therapy.
- The unadjusted proportion of patients completing at least 24 weeks of chemotherapy was similar between groups based on rurality, distance to health facility of diagnosis, deprivation status and ethnicity (37-49)%.

4.6.2.8 Discussion: adjuvant treatment for stage III colon cancer

By the time of the 2007-2008 PIPER cohort it was widely accepted by surgical and medical oncology specialists that adjuvant chemotherapy delivered after curative resection of stage III colon cancer can improve patient survival and was the standard of care. The medical oncology workforce was well established by 2007 with medical oncologists based at 6 cancer centres and also some regional centres, visiting medical oncology clinics at 23 hospitals and chemotherapy being delivered in more than 23 different hospitals and health facilities. The authors are unaware of any resource constraints during 2007/2008 which would have hampered delivery of chemotherapy to this cohort of patients.

A key finding of the PIPER cohort study is that only 59% (525/897) of stage III colon cancer patients received any adjuvant chemotherapy during 2007 & 2008. This figure compares with the publication of Hill et al (2010) where 50% of Māori patients (between 1996 and 2003) with stage III colon cancer (n = 301) and 64% of a randomly selected cohort of 328 non-Māori received adjuvant chemotherapy.[3]

These figures compare unfavourably with comparative international data from USA where Jessup et al (2005) reported on 14,187 stage III colon cancer in 2001-2002 and noted that 64% of patients received chemotherapy.[61] In Victoria Heong et. al. reported on a cohort of 987 patients with stage III colon cancer with 78% overall receiving adjuvant chemotherapy.[62] Their study was of 5 hospitals in Victoria and may not have reflected a truly representative population. Whether the patient and data capture in those studies was as comprehensive as the PIPER cohort is an open question.

The main steps involved in getting a patient with stage III colon cancer onto a course of adjuvant chemotherapy include (a) referral from surgeon to medical oncologist, (b) FSA with medical oncologist, (c) offer of chemotherapy to patient followed by (d) acceptance of chemotherapy offer. Attrition at any of these stages could have contributed to the overall modest figure of 59% of patients receiving chemotherapy. The data show that with each step there is a reduction in the proportions remaining from 100% to 77% (seen by a medical oncologist) to 67% (offered chemotherapy) to 59% (starting chemotherapy).

The largest of these steps/gaps is the first (non-referral) and possible contributors include strong patient preference not to pursue further treatment, variable surgeon enthusiasm for or belief in the effectiveness of adjuvant chemotherapy, delayed recovery from surgery (diluting the perceived benefit) or the presence of profound co-morbidity. There may some genuine

differences between the attitudes of NZ patients (compared with USA & Australia) regarding the risk/benefit equation of adjuvant chemotherapy which are not quantifiable by our study.

It is possible that patients not referred to a Medical Oncologist had been discussed at a MDM and a considered decision had been made not to offer chemotherapy because of co-morbidity evident at the time or a strong patient preference (known to the surgeon) that chemotherapy would not be pursued. Further delineation of those patients not having an FSA but discussed at an MDM might shed light on this theory. In the PIPER cohort 58% of patients were aged 70 or older (compared with 52% reported by Jessup et al and unknown in Heong 2014).[61, 62] The report by Heong et al revealed however that even within the cohort of patients >75 years in age the rate of adjuvant chemotherapy was 58%; a figure very similar to our overall result.[62] There is a possibility that ageism was resulting in a reduced rate of referral for a discussion about adjuvant chemotherapy. Detailed comparisons of the age and co-morbidity profile for those receiving chemotherapy versus those not might clarify these possibilities.

Of those receiving chemotherapy in the PIPER study only 47% (244/525) completed a full course of chemotherapy (at least 24 weeks) which equates to only 27% (244/897) of the whole eligible cohort. Comparative data to put this figure in context is lacking but most medical oncologists would consider this figure worryingly low and the possible reasons for this need to be studied in further detail.

The data showing the variations in chemotherapy regimens received by different sub-groups of patients defined according to ethnicity, distance from health facility of diagnosis and area of residence did not reveal any consistent trends but is likely to be confounded by other patient characteristics. Further work and analyses adjusted for demographic and clinical factors may be helpful in understanding the variation observed.

Highlights: stage III colon cancer – Adjuvant Treatment

Only 58% of stage III colon cancer patients received adjuvant chemotherapy compared to 64% in the USA and 75% in Australia

Rates of uptake of oxaliplatin did not vary by rurality of residence or distance to diagnosis facility (unadjusted comparison)

Less than half of patients completed 24 weeks of initially prescribed chemotherapy

4.7 Rectal Cancer: Presentation to hospital care

4.7.1 Key performance indicators (KPIs) for presentation for rectal cancer

The key performance indicators we have used for presentation to hospital care for rectal cancer patients are:

1. Emergency presentation into hospital care
2. Evidence of bowel obstruction at presentation

Presentation to the emergency department, as the service leading to the diagnosis of CRC, may be a surrogate measure for late presentation, severe symptoms, or the need for emergency surgery. Presentation to hospital care through the emergency department rather than outpatient referral may suggest barriers to or within primary care. Overall 36% of lung cancer patients in NZ present via the emergency department, with higher proportions of those of Pacific ethnicity presenting via ED.[30] The UK National Bowel Cancer audit reported that 21% of patients in the UK with CRC presented as an emergency, with substantial regional variation.

CRC presenting with bowel obstruction is recognised to be associated with poor prognosis, although is not specifically listed as a prognostic variable in the AJCC staging manual version 6. Bowel obstruction from colon cancer is associated with a survival decrement of as much as 25% at 5 years. This persists in most studies in multivariate analyses.[31] Obstruction is less common in rectal cancer, and is frequently treated in a different manner than for colon cancer; as obstructed rectal tumours are frequently more locally advanced, a loop colostomy or ileostomy may be formed and then neo-adjuvant chemoradiotherapy undertaken prior to resection of the primary tumour.

This contrasts with the situation for colon cancer whereby bowel obstruction and emergency presentation are associated with emergency surgery. Those who undergo emergency surgery in the UK have a mortality of 9.2% compared to 2.1% for those who undergo elective resection. [7] The relationship between emergency presentation, bowel obstruction and outcome in rectal cancer is incompletely understood.

4.7.2 PIPER analysis cohorts for rectal cancer

Of the 5667 patients in the total PIPER cohort, review of the hospital notes found one patient diagnosed during 2005, four diagnosed during 2010 and one diagnosed during 2012. For a further 19 patients the year of diagnosis was unknown. In addition, for 65 patients the site of the primary tumour was unknown. For those 65 patients much of the clinical data is missing, so they were excluded from further analysis. This left 1203 patients with rectal cancer in the main PIPER cohort (2007 and 2008) and 1396 in the extended PIPER cohort (2006-2009).

Table 4.7-1. Site of primary tumour by year of diagnosis as extracted from the clinical notes in the PIPER study

PIPER year of diagnosis	Site of primary tumour							
	Colon		Rectum		Unknown			
	N	%	N	%	N	%	Total	%
2005	1	0.0	0	0	0	0	1	0.0
2006	215	5.1	89	6.4	5	6.8	309	5.5
2007	1825	43.5	632	45.1	24	32.9	2481	43.8
2008	1892	45.1	571	40.8	19	26.0	2482	43.8
2009	249	5.9	104	7.4	17	23.3	370	6.5
2010	3	0.1	1	0.1	0	0	4	0.1
2012	0	0	1	0.1	0	0	1	0.0
Unknown	8	0.2	3	0.2	8	11.0	19	0.3
Total	**4193**	**100.0**	**1401**	**100.0**	**73**	**100.0**	**5667**	**100.0**

4.7.3 Presentation to hospital care for rectal cancer

4.7.3.1 Rurality of residence at diagnosis for rectal cancer

There were 1203 patients diagnosed with rectal cancer in the years 2007 and 2008. Of these rurality of residence at diagnosis was unknown for 31 patients, therefore there are 1172 patients included in the analyses in this section.

The overall proportion of patients presenting to hospital care as an emergency was 14% (95% CI: 12 to 16) (Table 4.7-2). The proportion was slightly higher for patients from urban areas (15% vs. 13%) but the difference was not statistically significant (p=0.6). The overall proportion presenting with obstruction was 8% (95% CI: 7 to 10). The proportion was lower in urban areas (7%) than in independent urban areas (12%) and rural areas (12%) (p=0.02). The proportions of patients who were first assessed by a gastroenterologist were 31% for urban areas, 14% for independent urban areas and 16% for rural areas (p<0.0001).
Further analyses in our second phase will consider the interplay of rurality, ethnicity, deprivation and distance on the proportions of patients presenting as an emergency.

Table 4.7-2 Emergency presentation into hospital care by rurality for patients with rectal cancer

Emergency presentation into hospital care	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-Value
Yes	123	14.9	24	12.5	21	13.5	168	14.3	p=0.6
No	663	80.4	163	84.9	130	83.9	956	81.6	
Unknown	39	4.7	5	2.6	4	2.6	48	4.1	
Total	825	100.0	192	100.0	155	100.0	1172	100.0	

Table 4.7-3 Evidence of obstruction at presentation by prioritised ethnicity for patients with rectal cancer

Evidence of obstruction	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-Value
Yes	58	7.0	22	11.5	19	12.3	99	8.4	0.02
No	734	89.0	161	83.9	128	82.6	1023	87.3	
Unknown	33	4.0	9	4.7	8	5.2	50	4.3	
Total	825	100.0	192	100.0	155	100.0	1172	100.0	

Table 4.7-4 Department undertaking first specialist assessment by prioritised ethnicity for patients with rectal cancer

Department undertaking FSA- final field	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Surgical	510	61.8	157	81.8	122	78.7	789	67.3	<0.0001
Gastroenterology	252	30.5	26	13.5	24	15.5	302	25.8	
General Medicine	39	4.7	6	3.1	5	3.2	50	4.3	
Medical Oncology	8	1.0	0	0	1	0.6	9	0.8	
Other medical specialty	5	0.6	0	0	0	0	5	0.4	
Emergency Department	2	0.2	0	0	0	0	2	0.2	
Obstetrics & Gynaecology	0	0	1	0.5	0	0	1	0.1	
Other surgical specialty	0	0	0	0	1	0.6	1	0.1	
Radiation Oncology	0	0	1	0.5	1	0.6	2	0.2	
Unknown	9	1.1	1	0.5	1	0.6	11	0.9	
Total	825	100.0	192	100.0	155	100.0	1172	100.0	

*p-value is calculated on a table with Other medical specialty to Radiation Oncology grouped as Other

4.7.3.2 Distance of residence from the health facility of diagnosis for rectal cancer

Of the 1203 patients with rectal cancer, distance of residence at diagnosis from the diagnostic facility was unknown for 36, therefore 1167 patients are included in the analyses in this section.

There were no marked differences in the proportions presenting as an emergency by distance of residence from the health facility of diagnosis (p=0.08), or in the proportions presenting with obstruction (p=0.1). The proportions of patients who were first assessed by a gastroenterologist were highest for patients living 5-20km from the health facility of diagnosis (30 -35% compared with 20-25% for areas that were closer or further away, p=0.002)

Table 4.7-5 Emergency presentation into hospital care by distance of residence from the health facility of diagnosis for patients with rectal cancer

Emergency presentation into hospital	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	67	16.3	37	15.9	25	13.6	17	8.2	22	16.9	168	14.4	0.08
No	336	81.6	187	80.3	145	78.8	182	87.5	105	80.8	955	81.8	
Unknown	9	2.2	9	3.9	14	7.6	9	4.3	3	2.3	44	3.8	
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0	

Table 4.7-6 Evidence of obstruction at presentation into hospital care by distance of residence from the health facility of diagnosis for patients with rectal cancer

Evidence of obstruction	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	37	9.0	17	7.3	9	4.9	19	9.1	17	13.1	99	8.5	0.1
No	361	87.6	207	88.8	166	90.2	184	88.5	104	80.0	1022	87.6	
Unknown	14	3.4	9	3.9	9	4.9	5	2.4	9	6.9	46	3.9	
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0	

Table 4.7-7 Department undertaking first specialist assessment by distance of residence from the health facility of diagnosis for patients with rectal cancer

Department undertaking FSA - final field	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Surgical	300	72.8	139	59.7	108	58.7	146	70.2	96	73.8	789	67.6	0.002
Gastroenterology	86	20.9	70	30.0	65	35.3	51	24.5	26	20.0	298	25.5	
General Medicine	19	4.6	13	5.6	6	3.3	8	3.8	4	3.1	50	4.3	
Medical Oncology	2	0.5	3	1.3	1	0.5	2	1.0	1	0.8	9	0.8	
Other medical specialty	2	0.5	2	0.9	1	0.5	0	0	0	0	5	0.4	
Emergency Department	0	0	2	0.9	0	0	0	0	0	0	2	0.2	
Obstetrics & Gynaecology	0	0	0	0	0	0	1	0.5	0	0	1	0.1	
Other surgical specialty	0	0	1	0.4	0	0	0	0	0	0	1	0.1	
Radiation Oncology	0	0	0	0	0	0	0	0	2	1.5	2	0.2	
Unknown	3	0.7	3	1.3	3	1.6	0	0	1	0.8	10	0.9	
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0	

*p-value is calculated on a table with Other medical specialty to Radiation Oncology grouped as Other

4.7.3.3 Area deprivation of residence at diagnosis for rectal cancer

Of the 1203 patients diagnosed with rectal cancer in 2007 and 2008 the NZ Deprivation Index for the meshblock of residence at diagnosis was unknown for 38 patients, therefore 1165 patients are included in the analysis below.

There were no marked differences in the proportions presenting as an emergency by distance of residence from the health facility of diagnosis (p=0.7), in the proportions presenting with obstruction (p=0.3) or in the service by which they were first assessed (p=0.7).

Table 4.7-8 Emergency presentation into hospital care by deprivation score of area residence at diagnosis for patients with rectal cancer

Emergency presentation into hospital	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	31	12.3	35	14.6	32	13.0	41	17.6	29	14.9	168	14.4	0.7
No	204	81.0	195	81.6	200	81.3	189	81.1	161	82.6	949	81.5	
Unknown	17	6.7	9	3.8	14	5.7	3	1.3	5	2.6	48	4.1	
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0	

*The NZ Deprivation Index is an area measure of deprivation. Higher values index indicate greater deprivation.

Table 4.7-9 Evidence of obstruction at presentation into hospital care by deprivation score of area residence at diagnosis for patients with rectal cancer

Evidence of obstruction	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	23	9.1	13	5.4	23	9.3	18	7.7	22	11.3	99	8.5	0.3
No	213	84.5	215	90.0	213	86.6	208	89.3	167	85.6	1016	87.2	
Unknown	16	6.3	11	4.6	10	4.1	7	3.0	6	3.1	50	4.3	
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0	

Table 4.7-10 Department undertaking first specialist assessment by deprivation score of area residence at diagnosis for patients with rectal cancer

Department undertaking FSA - final field	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Surgical	164	65.1	159	66.5	166	67.5	156	67.0	137	70.3	782	67.1	0.7
Gastroenterology	76	30.2	63	26.4	65	26.4	57	24.5	41	21.0	302	25.9	
General Medicine	7	2.8	9	3.8	10	4.1	12	5.2	12	6.2	50	4.3	
Medical Oncology	1	0.4	3	1.3	0	0	3	1.3	2	1.0	9	0.8	
Other medical specialty	1	0.4	0	0	1	0.4	2	0.9	1	0.5	5	0.4	
Emergency Department	0	0	0	0	1	0.4	1	0.4	0	0	2	0.2	
Obstetrics & Gynaecology	0	0	1	0.4	0	0	0	0	0	0	1	0.1	
Other surgical specialty	0	0	1	0.4	0	0	0	0	0	0	1	0.1	
Radiation Oncology	0	0	1	0.4	0	0	1	0.4	0	0	2	0.2	
Unknown	3	1.2	2	0.8	3	1.2	1	0.4	2	1.0	11	0.9	
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0	

*p-value is calculated on a table with Other medical specialty to Radiation Oncology grouped as Other

4.7.3.4 Ethnicity for rectal cancer

Of the 1396 patients diagnosed with rectal cancer in the extended PIPER cohort (2006 – 2009), ethnicity was unknown for 4 patients, therefore 1392 patients are included in this section.

The proportion of Pacific patients who presented as an emergency was 24%, for Māori it was 21% and for nMnP 13% (p=0.004). The proportions presenting with obstruction were similar in the 3 groups (p=0.4). The proportions who were first assessed by gastroenterology were 14% for Māori, 33% for Pacific and 26% for nMnP (p=0.002). Area of residence is likely to be a factor influencing these proportions, and that will be investigated in the second phase of analysis.

Table 4.7-11 Emergency presentation into hospital care by prioritised ethnicity for patients with rectal cancer

Emergency presentation into hospital	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	28	20.6	14	24.1	157	13.1	199	14.3	0.004
No	97	71.3	41	70.7	968	80.8	1106	79.5	
Unknown	11	8.1	3	5.2	73	6.1	87	6.3	
Total	136	100.0	58	100.0	1198	100.0	1392	100.0	

Table 4.7-12 Evidence of obstruction at presentation into hospital care by prioritised ethnicity for patients with rectal cancer

Evidence of obstruction	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	14	10.3	3	5.2	95	7.9	112	8.0	0.4
No	111	81.6	52	89.7	1033	86.2	1196	85.9	
Unknown	11	8.1	3	5.2	70	5.8	84	6.0	
Total	136	100.0	58	100.0	1198	100.0	1392	100.0	

Table 4.7-13 Department undertaking first specialist assessment by prioritised ethnicity for patients with rectal cancer

Department undertaking FSA - final field	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Surgical	99	72.8	32	55.2	795	66.4	926	66.5	0.002
Gastroenterology	19	14.0	19	32.8	313	26.1	351	25.2	
General Medicine	14	10.3	2	3.4	47	3.9	63	4.5	
Medical Oncology	0	0	1	1.7	9	0.8	10	0.7	
Other medical specialty	0	0	1	1.7	5	0.4	6	0.4	
Emergency Department	0	0	1	1.7	1	0.1	2	0.1	
Obstetrics & Gynaecology	0	0	0	0	1	0.1	1	0.1	
Other surgical specialty	0	0	0	0	1	0.1	1	0.1	
Radiation Oncology	0	0	0	0	2	0.2	2	0.1	
Unknown	4	2.9	2	3.4	24	2.0	30	2.2	
Total	136	100.0	58	100.0	1198	100.0	1392	100.0	

*p-value is calculated on a table with Other medical specialty to Radiation Oncology grouped as Other

4.7.4 Key points: for presentation for rectal cancer

Emergency presentation to hospital care:

- The proportion of patients with rectal cancer presenting to the emergency department was lower than that for colon cancer (14% vs. 34%). Higher proportions of Pacific and Māori diagnosed with rectal cancer presented via the emergency department than nMnP (21% and 24% compared to 13%; p=0.004)

Presentation with obstruction:

- 8% of rectal cancer patients presented with obstruction.
- Urban patients had a lower proportion presenting with obstruction (7%) compared to independent urban and rural (11.5% and 12.3%)
- The relationship between obstruction and distance to health facility of diagnosis was the inverse of that seen with colon

First specialist assessment:

- Independent urban and rural patients were more likely to be diagnosed following surgical FSA, and urban patients had the highest proportion diagnosed by gastroenterology.
- Although based on small numbers, the department of FSA was statistically significantly different by prioritised ethnicity, with 73% of Māori, 66% nMnP and 55% of Pacific presenting to a surgical department as FSA.
- Of interest, 10% of Māori presented to General Medicine, although numbers were very small (14/136)

4.7.5 Discussion: for presentation for rectal cancer

The proportion of patients presenting to the emergency department (ED) with CRC in NZ is notably higher than in the UK, although lower proportions of patients with rectal cancer present to the emergency department than patients with colon cancer. This may be because the cluster of symptoms for colon cancer such as change in bowel habit and tendency to looser stool are non-specific and have a broad differential diagnosis, and may potentially lead to lower concern amongst patients and health care providers. The symptoms of rectal cancer are often more overt, including rectal bleeding and tenesmus, which may alert patient and provider to the need for sigmoidoscopic evaluation. Furthermore, rectal tumours may be palpable by digital rectal examination whereas many patients presenting with colon cancer will have no discernible findings on clinical examination. These features combined may explain earlier referral to hospital care for rectal cancer patients and therefore fewer patients presenting as an emergency.

A discussion about the possible interaction between ethnicity and presentation to the emergency department is contained in 4.3.3 (Colon cancer presentation).

These results have not yet been adjusted for age or gender, and further analyses will be undertaken to help clarify the potential relationships between emergency presentation, site of primary tumour, ethnicity, rurality and deprivation.

The UK National Bowel Cancer Audit does not report on differential rates of presentation by colon and rectal cancer. The report notes proportions presenting as an emergency rather than presenting as bowel obstruction. Rates of emergency presentation in the UK vary by region, and this may reflect lack of screening, inadequacies in diagnostic services, or late engagement of patients with health-care providers. Emergency presentation could be highlighted as a variable for further study.

It is of note that our unadjusted analyses show differences in rates of presentation to emergency department and with obstruction by rurality, distance to health facility of diagnosis, deprivation, and ethnicity. The patterns differ by colon and rectal cancer, with a higher proportion of rural patients with rectal cancer presenting with obstruction compared to urban patients, whereas for colon cancer, the group with the highest proportion presenting with obstruction was the independent urban group. Disentangling the likely complex interrelations between these factors is beyond the scope of the currently funded project, but subsequent work is already planned to analyse this further.

Highlights: Rectal Cancer Presentation

14% of patients with rectal cancer presented via ED

8% of patients with rectal cancer presented with bowel obstruction

Surgical Services were the first speciality seen by 67% of patients with rectal cancer

Māori and Pacific patients were more likely to present to hospital care via ED than nMnP patients (unadjusted comparison)

4.8 Rectal Cancer: Demographic and clinical characteristics of patients at diagnosis

4.8.1 Demographic characteristics for rectal cancer

4.8.1.1 Rurality of residence at diagnosis for rectal cancer

Of the 1203 patients with rectal cancer, rurality of residence at diagnosis was unknown for 30, therefore 1172 patients are included in the analyses in this section.

Patients in rural areas tended to be younger that those from urban or independent urban areas. In particular, the proportions over 80 years of age were 11% for rural areas, 20% for urban areas and 23% for independent urban areas (Table 4.8-1). This means that any differences in management by age may manifest as differences in management by rurality, so care needs to be take in interpretation. There was only a small difference in the proportions of males and females in the urban/rural areas. The proportions of males were 65% for rural, 63% for urban and 59% for independent urban (Table 4.8-2).

The distribution of the comorbidity scores also varied by rurality of the area of residence (Figure 4.8.1, Table 4.8-3). The proportions with a comorbidity score of 2 or more were 15% for urban areas, 17% for independent urban areas and 10% for rural areas.

Table 4.8-1 Age (in years) at diagnosis by rurality of residence at diagnosis for patients with rectal cancer

	Diagnosis urban rural status							
Age at diagnosis	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
<40	20	2.4	0	0	3	1.9	23	2.0
40-49	48	5.8	7	3.6	17	11.0	72	6.1
50-59	118	14.3	22	11.5	32	20.6	172	14.7
60-69	215	26.1	63	32.8	55	35.5	333	28.4
70-79	257	31.2	55	28.6	31	20.0	343	29.3
>=80	167	20.2	45	23.4	17	11.0	229	19.5
Total	825	100.0	192	100.0	155	100.0	1172	100.0

Table 4.8-2 Gender by rurality of residence at diagnosis for patients with rectal cancer

Gender	Diagnosis urban rural status							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Female	308	37.3	80	41.7	57	36.8	445	38.0
Male	517	62.7	112	58.3	98	63.2	727	62.0
Total	825	100.0	192	100.0	155	100.0	1172	100.0

Table 4.8-3 C3 comorbidity score by rurality of residence at diagnosis for patients with rectal cancer

C3 comorbidity score	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
0	499	60.5	114	59.4	103	66.5	716	61.1
>0-1	108	13.1	26	13.5	22	14.2	156	13.3
>1-2	92	11.2	20	10.4	15	9.7	127	10.8
>2-3	45	5.5	9	4.7	6	3.9	60	5.1
>3	81	9.8	23	12.0	9	5.8	113	9.6
Total	825	100.0	192	100.0	155	100.0	1172	100.0

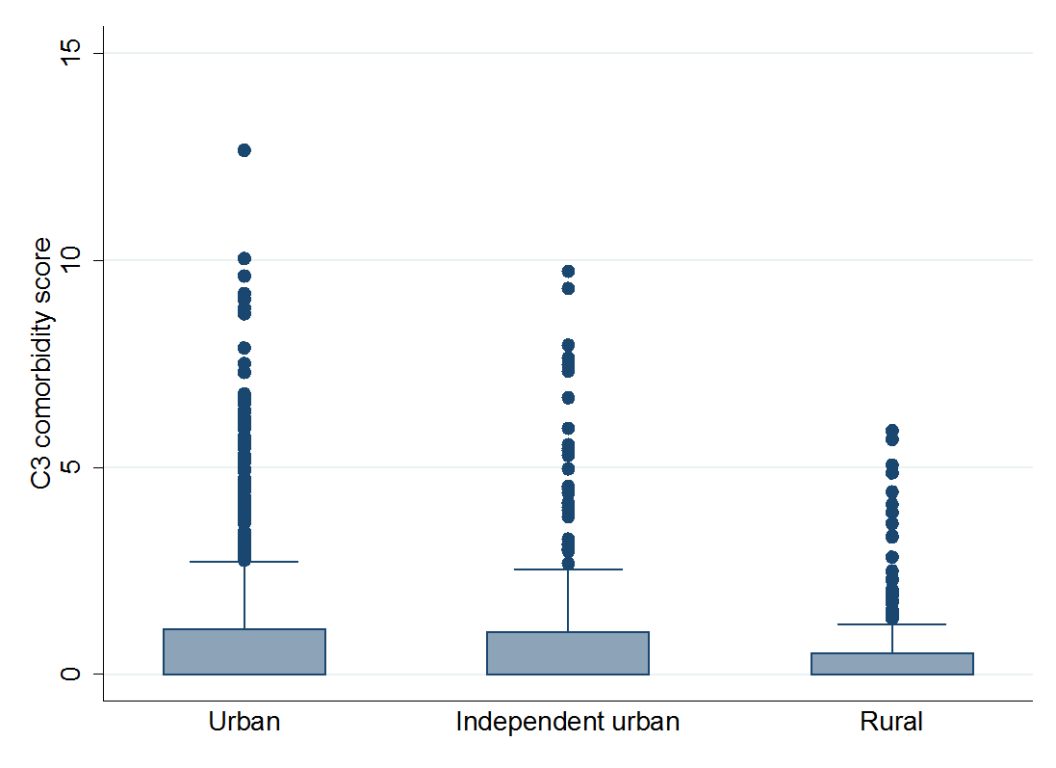

Figure 4.8-1 Baseline C3 comorbidity score by rurality for patients with rectal cancer.

4.8.1.2 Distance from health facility of diagnosis for rectal cancer

There were no notable differences in age distribution by the distance of the patients' residence from the health facility where they were diagnosed. (Table 4.8-4). The proportion of males living within 0-5km of the health facility was slightly lower than in the areas at a greater distance (57% vs. 63-68%) (Table 4.8-11). The distribution of the comorbidity scores did not appear to vary much with distance from the health facility of diagnosis (Figure 4.8.2, Table 4.8-6).

Table 4.8-4 Age at diagnosis by distance of residence from the health facility where diagnosis was made for patients with rectal cancer

Age at diagnosis	Diagnosis distance between meshblocks											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
<40	10	2.4	5	2.1	4	2.2	3	1.4	1	0.8	23	2.0
40-49	21	5.1	12	5.2	15	8.2	12	5.8	12	9.2	72	6.2
50-59	65	15.8	34	14.6	27	14.7	29	13.9	15	11.5	170	14.6
60-69	101	24.5	61	26.2	54	29.3	71	34.1	44	33.8	331	28.4
70-79	133	32.3	66	28.3	54	29.3	56	26.9	34	26.2	343	29.4
>=80	82	19.9	55	23.6	30	16.3	37	17.8	24	18.5	228	19.5
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0

Table 4.8-5 Gender by distance of residence from the health facility where diagnosis was made for patients with rectal cancer

Gender	Diagnosis distance between meshblocks											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Female	176	42.7	83	35.6	58	31.5	78	37.5	47	36.2	442	37.9
Male	236	57.3	150	64.4	126	68.5	130	62.5	83	63.8	725	62.1
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0

Table 4.8-6 C3 comorbidity scores by distance of residence from the health facility where diagnosis was made for patients with rectal cancer

C3 comorbidity score	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
0	246	59.7	135	57.9	121	65.8	133	63.9	77	59.2	712	61.0
0-1	56	13.6	32	13.7	21	11.4	30	14.4	17	13.1	156	13.4
1-2	44	10.7	32	13.7	21	11.4	17	8.2	13	10.0	127	10.9
2-3	20	4.9	15	6.4	5	2.7	10	4.8	10	7.7	60	5.1
>3	46	11.2	19	8.2	16	8.7	18	8.7	13	10.0	112	9.6
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0

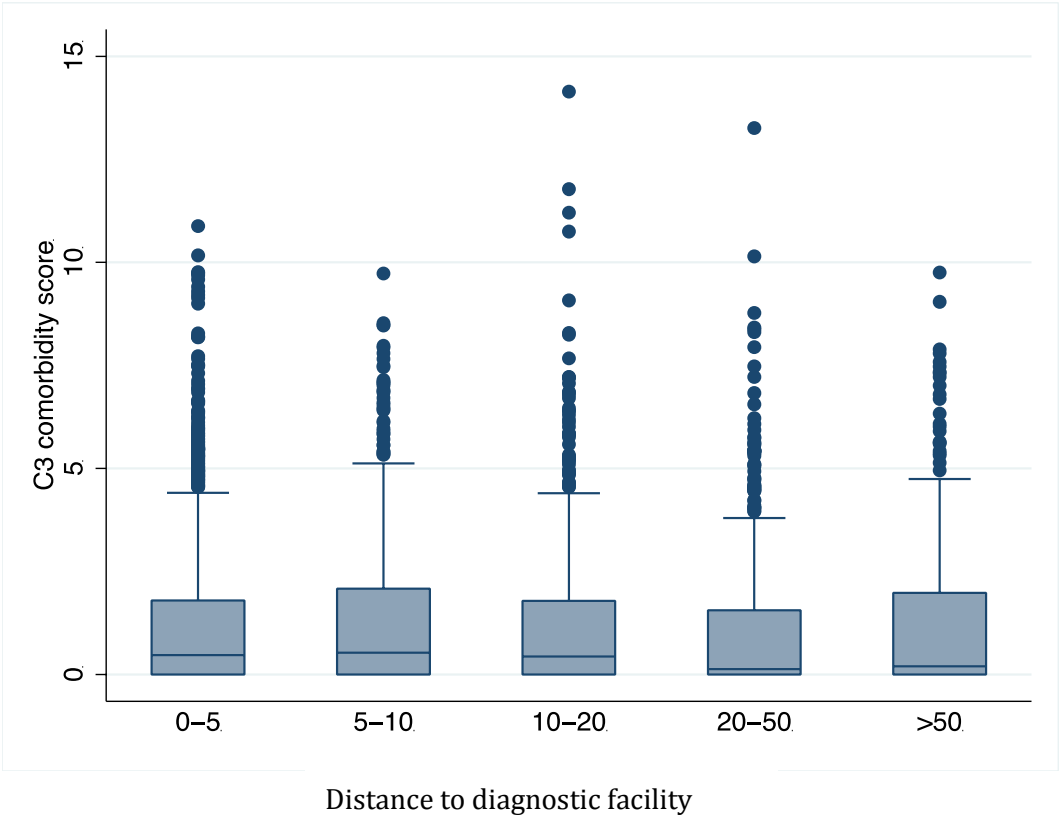

Figure 4.8-2. Baseline C3 comorbidity score by distance to diagnostic facility for patients with rectal cancer.

4.8.1.3 Area deprivation of residence at diagnosis for rectal cancer

The relationship between age at diagnosis and deprivation was not very strong, but patients in the lowest quintile of deprivation tended to be a little younger (Table 4.8-7). The low deprivation areas also had a slightly higher proportion of males than areas of higher deprivation (66% vs. 60-61%) (Table 4.8-8). Levels of comorbidity increased with higher deprivation (Figure 4.8-3). In the lowest quintiles of deprivation (1-2 and 3-4) the proportion of patients with a comorbidity score >3 were both 6%, whereas in the two areas of highest deprivation the proportions were 14% and 13% (Table 4.8-9).

Table 4.8-7 Age (in years) at diagnosis by area deprivation of residence at diagnosis for patients with rectal cancer

Age at diagnosis	Deprivation index 2006											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
<40	4	1.6	6	2.5	5	2.0	4	1.7	4	2.1	23	2.0
40-49	19	7.5	13	5.4	15	6.1	8	3.4	17	8.7	72	6.2
50-59	46	18.3	42	17.6	28	11.4	30	12.9	26	13.3	172	14.8
60-69	79	31.3	64	26.8	66	26.8	68	29.2	55	28.2	332	28.5
70-79	69	27.4	63	26.4	83	33.7	74	31.8	53	27.2	342	29.4
>80	35	13.9	51	21.3	49	19.9	49	21.0	40	20.5	224	19.2
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0

Table 4.8-8 Gender by area deprivation of residence at diagnosis for patients with rectal cancer

Gender	Deprivation index 2006											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Female	86	34.1	93	38.9	97	39.4	89	38.2	77	39.5	442	37.9
Male	166	65.9	146	61.1	149	60.6	144	61.8	118	60.5	723	62.1
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0

Table 4.8-9 C3 comorbidity by area deprivation of residence at diagnosis for patients with rectal cancer

C3 comorbidity score	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
0	170	67.5	154	64.4	152	61.8	129	55.4	105	53.8	710	60.9
0-1	32	12.7	36	15.1	25	10.2	28	12.0	35	17.9	156	13.4
1-2	23	9.1	22	9.2	31	12.6	32	13.7	18	9.2	126	10.8
2-3	12	4.8	12	5.0	13	5.3	11	4.7	12	6.2	60	5.2
>3	15	6.0	15	6.3	25	10.2	33	14.2	25	12.8	113	9.7
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0

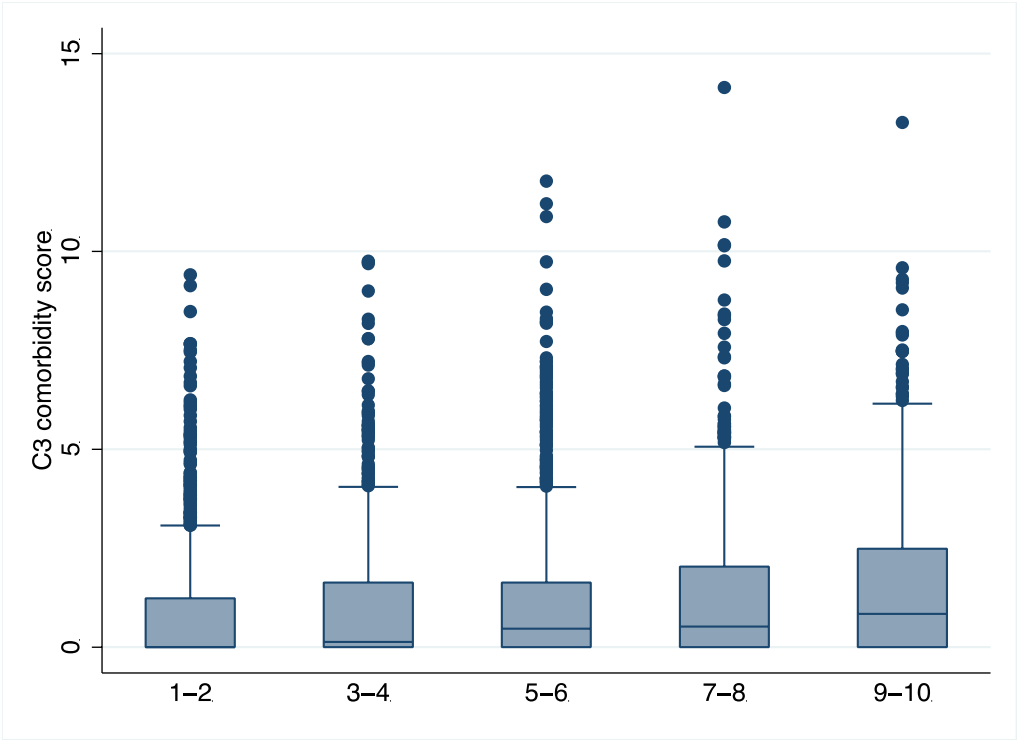

Figure 4.8-3 Baseline C3 comorbidity score by area deprivation of residence at diagnosis for patients with rectal cancer.

4.8.1.4 Ethnicity for rectal cancer

There were clear differences in age distribution by ethnicity. The proportion of Māori patients 70 years or older was 23%, of Pacific 28% and nMnP 50% (Table 4.8-10). There were only small differences in gender (Table 4.8-11). There were also only small differences in comorbidity, although this lack of association is likely to be a reflection of the younger distribution for Māori and Pacific patients (Table 4.8-12).

Table 4.8-10 Age (in years) by ethnicity for patients with rectal cancer

Age at diagnosis	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
<40	3	2.2	9	15.5	18	1.5	30	2.2
40-49	14	10.3	4	6.9	72	6.0	90	6.5
50-59	36	26.5	12	20.7	178	14.9	226	16.2
60-69	52	38.2	17	29.3	331	27.6	400	28.7
70-79	28	20.6	11	19.0	366	30.6	405	29.1
>=80	3	2.2	5	8.6	233	19.4	241	17.3
Total	136	100.0	58	100.0	1198	100.0	1392	100.0

Table 4.8-11 Gender by ethnicity for patients with rectal cancer

Gender	Prioritised Ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Female	47	34.6	23	39.7	450	37.6	520	37.4
Male	89	65.4	35	60.3	748	62.4	872	62.6
Total	136	100.0	58	100.0	1198	100.0	1392	100.0

Table 4.8-12 C3 comorbidity score by ethnicity for patients with rectal cancer

C3 comorbidity score	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
0	77	56.6	33	56.9	736	61.4	846	60.8
0-1	17	12.5	7	12.1	157	13.1	181	13.0
1-2	17	12.5	9	15.5	132	11.0	158	11.4
2-3	7	5.1	1	1.7	64	5.3	72	5.2
>3	18	13.2	8	13.8	109	9.1	135	9.7
Total	136	100.0	58	100.0	1198	100.0	1392	100.0

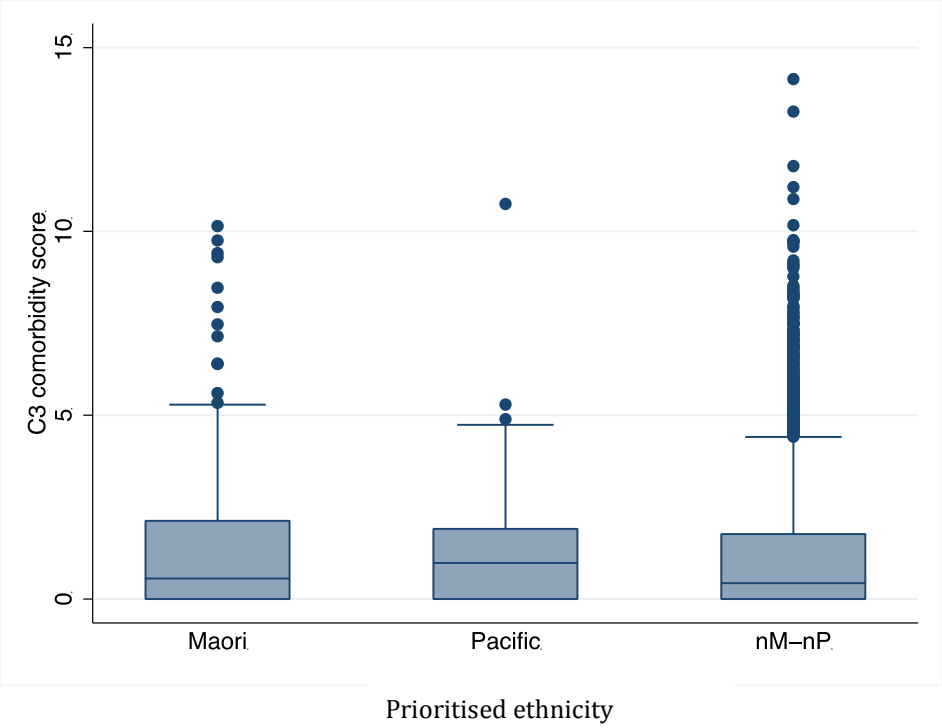

Figure 4.8-4 Baseline C3 comorbidity score by ethnicity for patients with rectal cancer.

4.8.2 Clinical characteristics at diagnosis for rectal cancer

4.8.2.1 Rurality of residence at diagnosis for rectal cancer

The overall proportion of patients who presented with metastatic rectal cancer was 19% (95% CI:16 to 21). The proportions were similar in the three urban/rural groups (p=0.5).

Table 4.8-13 Pre-op stage by rurality of residence at diagnosis for patients with rectal cancer

	Diagnosis urban rural status								
Pre-op stage	**Urban**		**Independent urban**		**Rural**				
	N	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-Value**
Non-metastatic	639	77.5	153	79.7	117	75.5	909	77.6	0.5
Metastatic	148	17.9	35	18.2	35	22.6	218	18.6	
Unknown	38	4.6	4	2.1	3	1.9	45	3.8	
Total	825	100.0	192	100.0	155	100.0	1172	100.0	

4.8.2.2 Distance of residence from health facility of diagnosis for rectal cancer

The proportion of patients who presented with metastatic rectal cancer varied from 17% to 25% among the distance groups, but there was no clear pattern and the differences were not statistically significant (p=0.2)

Table 4.8-14 Pre-operative stage by distance of residence from health facility where the diagnosis was made for patients with rectal cancer

Pre-op stage	Diagnosis distance between meshblocks												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-Value
Non-metastatic	325	78.9	172	73.8	143	77.7	169	81.3	95	73.1	904	77.5	0.2
Metastatic	68	16.5	48	20.6	33	17.9	36	17.3	33	25.4	218	18.7	
Unknown	19	4.6	13	5.6	8	4.3	3	1.4	2	1.5	45	3.9	
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0	

4.8.2.3 *Area deprivation of residence at diagnosis for rectal cancer*

The proportion of patients who presented with metastatic disease was higher in areas of greater deprivation. In the lowest quintile of deprivation (1-2) the proportion was 18%, and in the area of greatest deprivation (9-10) it was 24% (p=0.03) (Table 4.8-15).

Table 4.8-15 Pre-operative stage by area deprivation of residence at diagnosis for patients with rectal cancer

Pre-op stage	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Non-metastatic	190	75.4	197	82.4	200	81.3	175	75.1	141	72.3	903	77.5	0.03
Metastatic	46	18.3	35	14.6	37	15.0	52	22.3	47	24.1	217	18.6	
Unknown	16	6.3	7	2.9	9	3.7	6	2.6	7	3.6	45	3.9	
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0	

4.8.2.4 *Ethnicity for rectal cancer*

The proportion of Māori patients who presented with metastatic disease was 29%, for Pacific patients it was 22% and for nMnP it was 19% (p=0.007).

Table 4.8-16 Pre-operative stage by ethnicity for patients with rectal cancer

Pre-op stage	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Non-metastatic	91	66.9	42	72.4	926	77.3	1059	76.1	0.007
Metastatic	40	29.4	13	22.4	217	18.1	270	19.4	
Unknown	5	3.7	3	5.2	55	4.6	63	4.5	
Total	136	100.0	58	100.0	1198	100.0	1392	100.0	

4.8.3 Key points: demographic and clinical characteristics for rectal cancer

Regarding age and gender:

- Among patients with CRC the proportion of males with rectal cancer was much higher than for females (29% compared with 19%).
- Rural patients appeared to have a younger age distribution, as for colon cancer.
- Māori and Pacific had greater proportions of rectal cancer cases diagnosed at age under 50 compared with nMnP like colon cancer.

Regarding stage at presentation:

- Māori and Pacific had a greater proportion of patients with rectal cancer who are diagnosed with metastatic disease at presentation compared to nMnP (29%, 24% and 18% respectively). This is similar to what was seen in colon cancer.
- There was no clear indication in the unadjusted analyses that distance to health facility of diagnosis is related to stage at presentation.

Regarding deprivation, ethnicity and comorbidity:

- Rural patients diagnosed with rectal cancer had less comorbidity (using the C3 score), which is a similar finding to patients with colon cancer. This may reflect the younger rural population and will need to be age-adjusted to further understand this finding.
- Patients residing in the most deprived areas had higher C3 comorbidity scores than those from less deprived areas.
- Those from the least deprived areas appeared to have slightly younger age at diagnosis than those in the highest two deprivation groups; deciles 9-10 had the highest proportion of patients aged 80 years or over of all the deprivation groups.
- Māori and Pacific patients tended to be younger at diagnosis than nMnP patients.
- Those in the highest deprivation group had the lowest proportion of patients with non-metastatic disease at presentation, and were more likely to have unknown pre-op stage.
- Māori patients were more likely to present with metastatic disease than Pacific or nMnP patients.

Further analyses are required to understand the relationships between age, deprivation, ethnicity, stage, rurality, and distance to health facility of diagnosis.

4.8.4 Discussion: demographic and clinical characteristics for rectal cancer

This section describes the demographic and clinical characteristics of people diagnosed with rectal cancer. We found that, as for colon cancer, rural patients had a younger age at presentation and had less comorbidity. This may reflect the rural population as a whole – planned future publication will present incidence rates by rurality.

Patterns of colorectal primary tumour and stage at presentation in Pacific patients have not previously been described.

Māori and Pacific had a higher proportion of patients who were diagnosed with metastatic disease than nMnP. This is also reflected in the higher proportion of patients who presented via the emergency department, although differences in rates of obstruction were small. This

reflects the overall low incidence of obstruction with rectal cancer. The previous chapter discusses emergency presentation and obstruction by ethnicity.

The reasons why Māori and Pacific have higher proportions presenting with metastatic disease are not understood, and this is outside the scope of this report.

Previous work has demonstrated that those with the greatest socioeconomic deprivation are less likely to undergo resectional surgery than least deprived group, and have higher permanent stoma rates. The five year overall survival for rectal cancer was 31% lower for the most deprived compared to least deprived.[63] Other work has supported the finding that those with greatest socioeconomic deprivation have higher permanent stoma rates. [64]

Our project also demonstrates that those with the greatest socioeconomic deprivation had higher comorbidity scores and also have the lowest proportion diagnosed with non-metastatic disease. Further work is planned to explore the relationship between ethnicity, rurality, socioeconomic deprivation, comorbidity, stoma rates, and overall survival.

4.9 Rectal Cancer: Staging

4.9.1 Key performance indicators (KPIs) for staging for rectal cancer

The key performance indicators used for describing the staging of rectal cancer in this section are:

- Method of diagnosis
- Synoptic pathologic report
- Number of lymph nodes examined
- Staging with CT Abdomen/pelvis
- Completion of colonoscopy within one year
- Imaging (CT abdomen/pelvis, MRI pelvis)
- Complete staging

Other measures of interest include:

- Differentiation of tumour
- Lymphatic or vascular (lymphovascular) invasion
- CT staging with CT chest

The NZ Guidelines Group recommendations on the management of early CRC recommend that colonoscopy, Carcinoembryonic antigen (CEA), CT scan of abdomen and pelvis, and endorectal ultrasound or pelvic MRI be undertaken.[36] European guidelines recommend complete pre-operative colonoscopy, or early post-operative colonoscopy. It is noted that CT colonography may be used as an alternative where the lumen of the bowel is unable to be passed due to obstruction.[65] We did not manually collect CEA readings for this project.

Whilst many guidelines mandate CT scanning of the chest, one retrospective review found that CT scanning detected pulmonary metastases in 6% of patients and indeterminate lesions in 8.6%.[37] Given the paucity of data the benefit from routine CT staging of the chest has been questioned. [38] The NZGG does not mandate CT staging of the chest.

Of note, pathological confirmation of cancer is not explicitly recommended in either the European Society for Medical Oncology (ESMO) or NZGG recommendations, however it is explicitly recommended in the US National Comprehensive Cancer Network guidelines.

Although the current recommendation from the American Joint Committee on Cancer and the International Union Against Cancer is that 12 or more lymph nodes should be examined to appropriately stage rectal cancer, the optimal yield remains controversial. It is broadly acknowledged that lymph-node yield is affected by pre-operative chemoradiotherapy. In one review article, it was noted that the decrement in lymph node yield with pre-operative chemoradiotherapy was between 7 and 53%. [66]A single institution consecutive series of 116 patients found that the median number of nodes in patients treated or untreated with chemoradiotherapy was 16 and 19 respectively. They reported 64% of patients treated with chemoradiotherapy had 12 or more nodes identified. [67]

Others have argued that each additional lymph node examined increased the chance of stage III diagnosis by 3.9%, and that the optimal number of nodes retrieved to prevent stage migration was 16 if treated with chemoradiation and 18 if not.

4.9.2 Rurality of residence at diagnosis for rectal cancer

Of the 1203 patients with rectal cancer diagnosed in 2007 and 2008, rurality of residence at diagnosis known for 1172.

For the majority of patients their rectal cancer was diagnosed by colonoscopy (63%, 95%CI: 60 to 66) (Table 4.9-1). For 23% the method of initial diagnosis was sigmoidoscopy (95% CI: 20 to 25). Patients living in urban areas were more likely to be diagnosed by colonoscopy than those in independent urban areas (65% and 54% respectively, p=0.03).

Table 4.9-1 Method by which the initial diagnosis of rectal cancer was made by rurality of residence at the time of diagnosis for patients with rectal cancer

Initial diagnosis method	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	539	65.3	103	53.6	94	60.6	736	62.8	0.03
Sigmoidoscopy	171	20.7	59	30.7	37	23.9	267	22.8	
Surgery	77	9.3	21	10.9	18	11.6	116	9.9	
CT	12	1.5	2	1.0	2	1.3	16	1.4	
Percutaneous biopsy	6	0.7	5	2.6	2	1.3	13	1.1	
MRI	7	0.8	0	0	0	0	7	0.6	
Luminal biopsy unknown instrument	5	0.6	0	0	1	0.6	6	0.5	
Other	2	0.2	0	0	0	0	2	0.2	
Barium enema	1	0.1	0	0	0	0	1	0.1	
Clinical	1	0.1	0	0	0	0	1	0.1	
Unknown	4	0.5	2	1.0	1	0.6	7	0.6	
Total	825	100.0	192	100.0	155	100.0	1172	100.0	

*p-value compares colonoscopy, sigmoidoscopy, surgery and other methods combined.

Of the 1203 patients, 981 had had their primary tumour resected. Rurality of residence at diagnosis known for 956 of these.

Overall 51% of patients had a synoptic pathology report (95% CI: 48 to 55) (Table 4.9-2). There was some difference by rurality of the patient's residence: 54% of those in urban areas had a synoptic report, compared with only 43% in independent urban areas and 50% in rural areas (p=0.04). The overall proportion of patients with 12 or more lymph nodes examined was 49% (95% CI: 46 to 53) (Table 4.9-3). In patients living in independent urban areas the

proportion was 38%, compared with 53% for urban areas and 48% for rural areas (p=0.004). There was no difference in the number of positive lymph nodes found by rurality of residence (p=0.9) (Table 4.9-4), although this is hard to interpret when the numbers of lymph nodes examined differs.

The overall proportion of rectal cancer patients who had lymphovascular invasion was 23% (95% CI: 20 to 25) (Table 4.9-5). There was some difference in the proportions by rurality, but they were not statistically significant (p=0.3). The proportion of poorly or undifferentiated tumours was 13% (95% CI: 11 to 15). The proportion was slightly lower for urban patients than independent urban or rural patients, but the difference was not statistically significant (p=0.09).

Variations in the above surgical indicators are likely to reflect differences in clinical characteristics of the patients, such as stage of disease, and demographic characteristics, such as age. Further analysis of the reasons for observed differences in the crude proportions will be carried out in the second phase of our analysis.

Table 4.9-2 Synoptic pathology report from surgery for resection of primary by rurality of residence at diagnosis for patients with rectal cancer

Synoptic pathology report	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	361	53.6	68	43.3	62	49.2	491	51.4	0.04
No	305	45.3	89	56.7	62	49.2	456	47.7	
Unknown	7	1.0	0	0	2	1.6	9	0.9	
Total	673	100.0	157	100.0	126	100.0	956	100.0	

Table 4.9-3 Number of lymph nodes removed at surgery for resection of primary by rurality of residence at diagnosis for patients with rectal cancer

No. lymph nodes examined	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
<12 nodes	298	44.3	91	58.0	64	50.8	453	47.4	0.004
>=12 nodes	353	52.5	59	37.6	60	47.6	472	49.4	
Unknown	22	3.3	7	4.5	2	1.6	31	3.2	
Total	673	100.0	157	100.0	126	100.0	956	100.0	

Table 4.9-4 Number of positive lymph nodes by rurality of residence at diagnosis for patients with rectal cancer

No. positive lymph nodes	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
0	349	51.9	78	49.7	69	54.8	496	51.9	0.97
1-3	162	24.1	38	24.2	29	23.0	229	24.0	
4-12	89	13.2	16	10.2	18	14.3	123	12.9	
>12	14	2.1	2	1.3	3	2.4	19	2.0	
Unknown	59	8.8	23	14.6	7	5.6	89	9.3	
Total	673	100.0	157	100.0	126	100.0	956	100.0	

Table 4.9-5 Lymphovascular invasion by rurality of residence at diagnosis for patients with rectal cancer for patients with rectal cancer

Lymphovascular invasion	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	169	25.1	27	17.2	21	16.7	217	22.7	0.3
No	415	61.7	89	56.7	70	55.6	574	60.0	
Unknown	89	13.2	41	26.1	35	27.8	165	17.3	
Total	673	100.0	157	100.0	126	100.0	956	100.0	

Table 4.9-6 Differentiation of the tumour cells by rurality of residence at diagnosis for patients with rectal cancer

Differentiation	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Well	126	18.7	17	10.8	13	10.3	156	16.3	0.09
Moderate	338	50.2	86	54.8	70	55.6	494	51.7	
Poor	82	12.2	13	8.3	13	10.3	108	11.3	
Undifferentiated	10	1.5	3	1.9	3	2.4	16	1.7	
Unknown	117	17.4	38	24.2	27	21.4	182	19.0	
Total	673	100.0	157	100.0	126	100.0	956	100.0	

Colonoscopy, CT, and MRI are used to ensure detection of any second primary tumours or metastatic disease. For patients who presented acutely, 64% had a CT scan of the abdomen and pelvis within an 8 week window around their date of surgery (95% CI: 56 to 71) (Table 4.9-7). For patients who did not present acutely 71% had a CT scan of the abdomen and pelvis within 8 weeks *before* surgery (95% CI: 68 to 74).

The proportion of patients who presented acutely who had a CT scan of the chest within an 8 week window around their date of surgery was 39% (95% CI: 31 to 46) (Table 4.9-8). For patients who did not present acutely the proportion who had a CT scan of the chest within 8 weeks *before* surgery was 48% (95% CI: 45 to 51).

MRI is reported only for patients who presented with non-metastatic rectal cancer. For those who presented acutely the proportion who had an MRI of the pelvis within an 8 week window around their surgery was 55% (95% CI: 45 to 64) (Table 4.9-9). For patients who did not present acutely the proportion who had an MRI of the pelvis within 8 weeks *before* surgery was 60% (95% CI: 56 to 63).

Table 4.9-7 CT scan of the abdomen and pelvis by rurality of residence at diagnosis for patients with rectal cancer

CT of abdo/pelvis within 8 weeks		Rurality of residence at time of diagnosis							
		Urban		Independent urban		Rural			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdo/pelvis**								
Yes	**Within 8 weeks before first treatment**	74	60.2	12	50.0	11	52.4	97	8.3
	Within 8 weeks after first treatment	5	4.1	1	4.2	4	19.0	10	0.9
	None within 8 weeks of first treatment	16	13.0	5	20.8	0	0	21	1.8
	Unknown or no treatment	28	22.8	6	25.0	6	28.6	40	3.4
	Total	123	100.0	24	100.0	21	100.0	168	14.3
No	**CT of abdo/pelvis**								
	Within 8 weeks before first treatment	463	69.8	120	73.6	93	71.5	676	57.7
	Within 8 weeks after first treatment	23	3.5	5	3.1	6	4.6	34	2.9
	None within 8 weeks of first treatment	130	19.6	30	18.4	27	20.8	187	16.0
	Unknown or no treatment	47	7.1	8	4.9	4	3.1	59	5.0
	Total	663	100.0	163	100.0	130	100.0	956	81.6
Unknown	**CT of abdo/pelvis**								
	Within 8 weeks before first treatment	24	61.5	2	40.0	4	100.0	30	2.6
	Within 8 weeks after first treatment	2	5.1	1	20.0	0	0	3	0.3
	None within 8 weeks of first treatment	13	33.3	2	40.0	0	0	15	1.3
	Total	39	100.0	5	100.0	4	100.0	48	4.1
	Total	825	100.0	192	100.0	155	100.0	1172	100.0

Table 4.9-8 CT scan of the chest by rurality of residence at diagnosis for patients with rectal cancer

CT of chest within 8 weeks		Rurality of residence at time of diagnosis: Urban N	Urban %	Independent urban N	Independent urban %	Rural N	Rural %	Total	%
Acute presentation	**CT of chest**								
Yes	**Within 8 weeks before first treatment**	51	41.5	6	25.0	4	19.0	61	5.2
	Within 8 weeks after first treatment	1	0.8	1	4.2	2	9.5	4	0.3
	None within 8 weeks of first treatment	43	35.0	11	45.8	9	42.9	63	5.4
	Unknown or no treatment	28	22.8	6	25.0	6	28.6	40	3.4
	Total	123	100.0	24	100.0	21	100.0	168	14.3
No	**CT of chest**								
	Within 8 weeks before first treatment	323	48.7	79	48.5	57	43.8	459	39.2
	Within 8 weeks after first treatment	18	2.7	5	3.1	7	5.4	30	2.6
	None within 8 weeks of first treatment	275	41.5	71	43.6	62	47.7	408	34.8
	Unknown or no treatment	47	7.1	8	4.9	4	3.1	59	5.0
	Total	663	100.0	163	100.0	130	100.0	956	81.6
Unknown	**CT of chest**								
	Within 8 weeks before first treatment	19	48.7	2	40.0	4	100.0	25	2.1
	Within 8 weeks after first treatment	1	2.6	1	20.0	0	0	2	0.2
	None within 8 weeks of first treatment	19	48.7	2	40.0	0	0	21	1.8
	Total	39	100.0	5	100.0	4	100.0	48	4.1
	Total	825	100.0	192	100.0	155	100.0	1172	100.0

Table 4.9-9 MRI of the pelvis by rurality of residence at diagnosis for patients with stage non-metastatic rectal cancer

MRI within 8 weeks (non-metastatic rectal cancer)		Rurality of residence at time of diagnosis: Urban N	Urban %	Independent urban N	Independent urban %	Rural N	Rural %	Total	%
Acute presentation	**MRI of pelvis**								
Yes	**Within 8 weeks before first treatment**	49	53.3	9	56.3	5	38.5	63	6.9
	Within 8 weeks after first treatment	3	3.3	0	0	0	0	3	0.3
	None within 8 weeks of first treatment	26	28.3	5	31.3	6	46.2	37	4.1
	Unknown or no treatment	14	15.2	2	12.5	2	15.4	18	2.0
	Total	92	100.0	16	100.0	13	100.0	121	13.3
No	**MRI of pelvis**								
	Within 8 weeks before first treatment	297	57.9	81	60.9	66	66.0	444	48.8
	Within 8 weeks after first treatment	2	0.4	1	0.8	3	3.0	6	0.7
	None within 8 weeks of first treatment	195	38.0	48	36.1	30	30.0	273	30.0
	Unknown or no treatment	19	3.7	3	2.3	1	1.0	23	2.5
	Total	513	100.0	133	100.0	100	100.0	746	82.1
Unknown	**MRI of pelvis**								
	Within 8 weeks before first treatment	12	35.3	1	25.0	2	50.0	15	1.7
	None within 8 weeks of first treatment	22	64.7	3	75.0	2	50.0	27	3.0
	Total	34	100.0	4	100.0	4	100.0	42	4.6
	Total	639	100.0	153	100.0	117	100.0	909	100.0

Of the 1203 patients diagnosed with rectal cancer in 2007 and 2008, 924 had non-metastatic disease, and of these 847 had had their primary tumour resected. Rurality of residence was known for 832.

For this report, the proportion of patients who had had a colonoscopy by 1 year is reported only for those patients who are still alive and free from progression of disease at 1 year (496 patients, Table 4.9-10). Colonoscopies before surgery were counted only if they were reported as being complete. The overall proportion of these patients who had had a colonoscopy by 1 year was 62% (95% CI: 58% to 65%). The differences between urban and rural areas was not statistically significant (p=0.06).

Looking across colonoscopy, CT scans and MRI, for patients with non-metastatic rectal cancer who received some treatment, only 32% (95% CI: 29 to 35) had complete staging (defined as colonoscopy within 1 year, CT scan of the abdomen and pelvis and MRI within 8 weeks) (Table 4.9-12). The proportion did not vary by rurality (0.7).

For patients with metastatic rectal cancer who received some treatment, 59% (95% CI: 51 to 67) had complete staging (complete staging included CT of the abdomen and pelvis and the chest). Numbers were smaller, so estimates in separate urban and rural areas were imprecise, but there was no evidence of a difference by rurality.

Table 4.9-10 Disease outcomes by rurality of residence at diagnosis for patients with rectal cancer

Alive and disease free at 1 year	Diagnosis urban rural status								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
No treatment date	2	0.3	0	0	0	0	2	0.2	0.2
Sill alive and progression free	342	58.8	79	56.0	75	68.8	496	59.6	
Progressed or died within a year	64	11.0	22	15.6	10	9.2	96	11.5	
Progressed or died after 1yr	174	29.9	40	28.4	24	22.0	238	28.6	
Total	582	100.0	141	100.0	109	100.0	832	100.0	

*Date of first treatment is unknown

Table 4.9-11 Colonoscopy within 1 year of initial treatment for patients who were still alive and progression free at 1 year by rurality of residence at diagnosis for patients with rectal cancer

Colonoscopy within 1 year	Diagnosis urban rural status: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	333	64.5	68	57.1	53	53.5	454	61.9	0.06
No	183	35.5	51	42.9	46	46.5	280	38.1	
Total	516	100.0	119	100.0	99	100.0	734	100.0	

Table 4.9-12 Completeness of staging by rurality of residence at diagnosis for patients with stage non-metastatic rectal cancer who were alive and disease free at 1 year

Completeness of staging (Stage I-III)	Diagnosis urban rural status: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	169	32.8	36	30.3	29	29.3	234	31.9	0.7
No	347	67.2	83	69.7	70	70.7	500	68.1	
Total	516	100.0	119	100.0	99	100.0	734	100.0	

Table 4.9-13 Completeness of staging by rurality of residence at diagnosis for patients with metastatic rectal cancer who were alive and disease free at 1 year

Completeness of staging (Stage IV)	Diagnosis urban rural status: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	73	64.0	15	55.6	13	43.3	101	59.1	0.1
No	41	36.0	12	44.4	17	56.7	70	40.9	
Total	114	100.0	27	100.0	30	100.0	171	100.0	

4.9.3 Distance of residence at diagnosis from health facility of diagnosis for rectal cancer

Of the 1203 patients with rectal cancer diagnosed in 2007 and 2008, the distance of residence at diagnosis from the health facility where their disease was diagnosed was known for 1167. Patients living closer to the health facility where their disease was diagnosed had a higher proportion who were diagnosed by colonoscopy than patients from areas further away, although the differences were not statistically (p=0.06) (Table 4.9-14).

Of the 981 patients who had their tumour resected, the distance from their residence to the health facility of diagnosis known for 951.

The proportion of patients who had a synoptic pathology report from the resection was higher for those living 5-10km from the health facility of diagnosis, 62% compared with 46-54% at distances nearer to or further from the health facility (Table 4.9-15) (p=0.02). There was no statistically significant difference in the number of lymph nodes examined or the number of positive lymph nodes found by distance of residence from the health facility (p=0.1 and 0.97 respectively) (Table 4.9-16, Table 4.9-17).

The proportion of patients with lymphovascular space invasion did not vary by distance of residence from the health facility of diagnosis (p=0.1) (Table 4.9-18). There were slightly higher proportions of patients with well differentiated tumours living 5-10 and 10-20km from the health facility of diagnosis but this difference was not statistically significant (p=0.08) (Table 4.9-1).

The relative proportions of patients who had CT scans depended on the method of presentation to hospital care. For patients who presented acutely the proportion who had a CT scan of the abdomen and pelvis was 67% for those living 0-5 km from the health facility where the diagnosis was made, whereas for those living further away the proportions were 47-57% (Table 4.9-20). For patients who did not present acutely the proportions were similar (between 68% and 75%). Similarly for CT of the chest: the proportions for patients living 0-5 and 5-10km away were 41% and 42% respectively, whereas for those living further away they ranged from 18-32% (Table 4.9-21). For MRI, 86% of the patients who presented acutely and lived within 5-10km of the health facility had an MRI compared with 46-64% in the other groups. The proportions were very similar in the distance groups among those who did not present acutely (54-70%) (Table 4.9-22).

Colonoscopy by 1 year, and completeness of staging for both non-metastatic and metastatic patients followed a similar pattern by distance to the CT scans, but none of the differences were statistically significant.

Table 4.9-14 Method by which the initial diagnosis of rectal cancer was made by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

Initial diagnosis method	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	253	61.4	164	70.4	124	67.4	121	58.2	71	54.6	733	62.8	0.06
Sigmoidoscopy	101	24.5	44	18.9	35	19.0	54	26.0	33	25.4	267	22.9	
Surgery	41	10.0	16	6.9	16	8.7	23	11.1	18	13.8	114	9.8	
CT	3	0.7	3	1.3	6	3.3	2	1.0	2	1.5	16	1.4	
Percutaneous biopsy	4	1.0	2	0.9	0	0	5	2.4	2	1.5	13	1.1	
MRI	4	1.0	1	0.4	1	0.5	1	0.5	0	0	7	0.6	
Luminal biopsy unknown instrument	0	0	2	0.9	1	0.5	1	0.5	2	1.5	6	0.5	
Other	1	0.2	0	0	0	0	1	0.5	0	0	2	0.2	
Barium enema	1	0.2	0	0	0	0	0	0	0	0	1	0.1	
Clinical	1	0.2	0	0	0	0	0	0	0	0	1	0.1	
Unknown	3	0.7	1	0.4	1	0.5	0	0	2	1.5	7	0.6	
Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0	

*p-value compares colonoscopy, sigmoidoscopy, surgery and other methods combined.

Table 4.9-15 Synoptic pathology report from surgery for resection of primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

Synoptic pathology report	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	161	47.4	112	61.9	70	45.8	94	54.0	53	51.5	490	51.5	0.02
No	174	51.2	69	38.1	81	52.9	79	45.4	50	48.5	453	47.6	
Unknown	5	1.5	0	0	2	1.3	1	0.6	0	0	8	0.8	
Total	340	100.0	181	100.0	153	100.0	174	100.0	103	100.0	951	100.0	

Table 4.9-16 Number of lymph nodes examined at surgery for resection of primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

No. lymph nodes examined	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
<12 nodes	172	50.6	83	45.9	61	39.9	87	50.0	47	45.6	450	47.3	0.1
>=12 nodes	152	44.7	96	53.0	87	56.9	81	46.6	54	52.4	470	49.4	
Unknown	16	4.7	2	1.1	5	3.3	6	3.4	2	1.9	31	3.3	
Total	340	100.0	181	100.0	153	100.0	174	100.0	103	100.0	951	100.0	

Table 4.9-17 Number of positive lymph nodes by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

No. positive lymph nodes	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
0	171	50.3	93	51.4	87	56.9	90	51.7	55	53.4	496	52.2	0.97
1-3	80	23.5	43	23.8	33	21.6	41	23.6	27	26.2	224	23.6	
4-12	40	11.8	28	15.5	18	11.8	25	14.4	12	11.7	123	12.9	
>12	8	2.4	4	2.2	1	0.7	4	2.3	2	1.9	19	2.0	
Unknown	41	12.1	13	7.2	14	9.2	14	8.0	7	6.8	89	9.4	
Total	340	100.0	181	100.0	153	100.0	174	100.0	103	100.0	951	100.0	

Table 4.9-18 Lymphovascular space invasion by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

Lymphovascular invasion	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	72	21.2	54	29.8	37	24.2	33	19.0	20	19.4	216	22.7	0.1
No	206	60.6	100	55.2	92	60.1	107	61.5	67	65.0	572	60.1	
Unknown	62	18.2	27	14.9	24	15.7	34	19.5	16	15.5	163	17.1	
Total	340	100.0	181	100.0	153	100.0	174	100.0	103	100.0	951	100.0	

Table 4.9-19 Differentiation of the tumour by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

Differentiation	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Well	45	13.2	37	20.4	35	22.9	28	16.1	10	9.7	155	16.3	0.08
Moderate	180	52.9	82	45.3	77	50.3	88	50.6	64	62.1	491	51.6	
Poor	41	12.1	23	12.7	15	9.8	18	10.3	11	10.7	108	11.4	
Undifferentiated	3	0.9	4	2.2	1	0.7	5	2.9	3	2.9	16	1.7	
Unknown	71	20.9	35	19.3	25	16.3	35	20.1	15	14.6	181	19.0	
Total	340	100.0	181	100.0	153	100.0	174	100.0	103	100.0	951	100.0	

Table 4.9-20 CT scan of the abdomen and pelvis by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

CT abdo/pelvis within 8 weeks		Distance from residence to facility of diagnosis (km)											
		0-<5		5-<10		10-<20		20-<50		50>/=			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdomen and pelvis**												
Yes	**Within 8 weeks before first treatment**	45	67.2	21	56.8	12	48.0	8	47.1	11	50.0	97	8.3
	Within 8 weeks after first treatment	3	4.5	1	2.7	2	8.0	1	5.9	3	13.6	10	0.9
	None within 8 weeks of first treatment	6	9.0	4	10.8	4	16.0	2	11.8	5	22.7	21	1.8
	Unknown or no treatment	13	19.4	11	29.7	7	28.0	6	35.3	3	13.6	40	3.4
	Total	67	100.0	37	100.0	25	100.0	17	100.0	22	100.0	168	14.4
No	**CT of abdomen and pelvis**												
	Within 8 weeks before first treatment	239	71.1	134	71.7	99	68.3	136	74.7	68	64.8	676	57.9
	Within 8 weeks after first treatment	13	3.9	6	3.2	6	4.1	5	2.7	4	3.8	34	2.9
	None within 8 weeks of first treatment	60	17.9	33	17.6	29	20.0	35	19.2	29	27.6	186	15.9
	Unknown or no treatment	24	7.1	14	7.5	11	7.6	6	3.3	4	3.8	59	5.1
	Total	336	100.0	187	100.0	145	100.0	182	100.0	105	100.0	955	81.8
Unknown	**CT of abdomen and pelvis**												
	Within 8 weeks before first treatment	7	77.8	7	77.8	8	57.1	5	55.6	2	66.7	29	2.5
	Within 8 weeks after first treatment	0	0	2	22.2	0	0	1	11.1	0	0	3	0.3
	None within 8 weeks of first treatment	2	22.2	0	0	6	42.9	3	33.3	1	33.3	12	1.0
	Total	9	100.0	9	100.0	14	100.0	9	100.0	3	100.0	44	3.8
	Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0

Table 4.9-21 CT scan of the chest by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

		Distance from residence to facility of diagnosis (km)											
Ct chest within 8 weeks		0-<5		5-<10		10-<20		20-<50		50>/=			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT of chest**												
Yes	**Within 8 weeks before first treatment**	28	41.8	16	43.2	8	32.0	3	17.6	6	27.3	61	5.2
	Within 8 weeks after first treatment	0	0	1	2.7	1	4.0	1	5.9	1	4.5	4	0.3
	None within 8 weeks of first treatment	26	38.8	9	24.3	9	36.0	7	41.2	12	54.5	63	5.4
	Unknown or no treatment	13	19.4	11	29.7	7	28.0	6	35.3	3	13.6	40	3.4
	Total	67	100.0	37	100.0	25	100.0	17	100.0	22	100.0	168	14.4
No	**CT of chest**												
	Within 8 weeks before first treatment	153	45.5	93	49.7	74	51.0	92	50.5	47	44.8	459	39.3
	Within 8 weeks after first treatment	12	3.6	3	1.6	7	4.8	5	2.7	3	2.9	30	2.6
	None within 8 weeks of first treatment	147	43.8	77	41.2	53	36.6	79	43.4	51	48.6	407	34.9
	Unknown or no treatment	24	7.1	14	7.5	11	7.6	6	3.3	4	3.8	59	5.1
	Total	336	100.0	187	100.0	145	100.0	182	100.0	105	100.0	955	81.8
Unknown	**CT of chest**												
	Within 8 weeks before first treatment	6	66.7	6	66.7	6	42.9	4	44.4	2	66.7	24	2.1
	Within 8 weeks after first treatment	0	0	1	11.1	0	0	1	11.1	0	0	2	0.2
	None within 8 weeks of first treatment	3	33.3	2	22.2	8	57.1	4	44.4	1	33.3	18	1.5
	Total	9	100.0	9	100.0	14	100.0	9	100.0	3	100.0	44	3.8
	Total	412	100.0	233	100.0	184	100.0	208	100.0	130	100.0	1167	100.0

Table 4.9-22 MRI of the pelvis by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

MRI within 8 weeks (non-metastatic patients)		Distance from residence to facility of diagnosis (km)											
		0-<5		5-<10		10-<20		20-<50		50>/=			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**MRI of pelvis**												
Yes	**Within 8 weeks before first treatment**	25	48.1	19	70.4	9	56.3	4	33.3	6	42.9	63	7.0
	Within 8 weeks after first treatment	2	3.8	0	0	1	6.3	0	0	0	0	3	0.3
	None within 8 weeks of first treatment	18	34.6	4	14.8	4	25.0	4	33.3	7	50.0	37	4.1
	Unknown	7	13.5	4	14.8	2	12.5	4	33.3	1	7.1	18	2.0
	Total	52	100.0	27	100.0	16	100.0	12	100.0	14	100.0	121	13.4
No	**MRI of pelvis**												
	Within 8 weeks before first treatment	147	55.3	89	64.0	61	53.5	105	70.9	42	53.8	444	49.1
	Within 8 weeks after first treatment	2	0.8	1	0.7	2	1.8	1	0.7	0	0	6	0.7
	None within 8 weeks of first treatment	106	39.8	45	32.4	47	41.2	40	27.0	34	43.6	272	30.1
	Unknown	11	4.1	4	2.9	4	3.5	2	1.4	2	2.6	23	2.5
	Total	266	100.0	139	100.0	114	100.0	148	100.0	78	100.0	745	82.4
Unknown	**MRI of pelvis**												
	Within 8 weeks before first treatment	2	28.6	3	50.0	7	53.8	2	22.2	1	33.3	15	1.7
	None within 8 weeks of first treatment	5	71.4	3	50.0	6	46.2	7	77.8	2	66.7	23	2.5
	Total	7	100.0	6	100.0	13	100.0	9	100.0	3	100.0	38	4.2
	Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	904	100.0

Table 4.9-23 Disease outcomes by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

Alive and disease free at 1 year	Diagnosis distance between meshblocks												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
No treatment date*	1	0.3	0	0	0	0	1	0.6	0	0	2	0.2	0.8
Sill alive and progression free	179	60.1	88	58.3	83	61.5	93	60.0	49	55.7	492	59.5	
Progressed or died within a year	29	9.7	16	10.6	17	12.6	22	14.2	12	13.6	96	11.6	
Progressed or died after 1yr	89	29.9	47	31.1	35	25.9	39	25.2	27	30.7	237	28.7	
Total	298	100.0	151	100.0	135	100.0	155	100.0	88	100.0	827	100.0	

*Date of first treatment is unknown

Table 4.9-24 Colonoscopy within 1 year of initial treatment for patients who were still alive and progression free at 1 year by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for rectal cancer patients

Colonoscopy within 1 year	Diagnosis distance between meshblocks												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	159	59.3	92	68.1	77	65.3	81	61.4	44	57.9	453	62.1	0.4
No	109	40.7	43	31.9	41	34.7	51	38.6	32	42.1	276	37.9	
Total	268	100.0	135	100.0	118	100.0	132	100.0	76	100.0	729	100.0	

Table 4.9-25 Completeness of staging at diagnosis for patients with non-metastatic rectal cancer who were alive and disease free at 1 year by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

Completeness of staging (Stage I-III)	Diagnosis distance between meshblocks												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	82	30.6	51	37.8	33	28.0	48	36.4	20	26.3	234	32.1	0.2
No	186	69.4	84	62.2	85	72.0	84	63.6	56	73.7	495	67.9	
Total	268	100.0	135	100.0	118	100.0	132	100.0	76	100.0	729	100.0	

Table 4.9-26 Completeness of staging at diagnosis for patients with metastatic rectal cancer who were alive and disease free at 1 year by distance of residence at the time of diagnosis from the health facility where the diagnosis was made

Completeness of staging (Stage IV)	Diagnosis distance between meshblocks												
	0-<5		5-<10		10-<20		20-<50		50-<100				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	32	60.4	25	71.4	12	54.5	18	58.1	14	46.7	101	59.1	0.4
No	21	39.6	10	28.6	10	45.5	13	41.9	16	53.3	70	40.9	
Total	53	100.0	35	100.0	22	100.0	31	100.0	30	100.0	171	100.0	

4.9.4 Area deprivation of residence at diagnosis for rectal cancer

Of the 1203 patients with rectal cancer diagnosed in 2007 and 2008, the NZ Deprivation Index score of their meshblock of residence at diagnosis was known for 1165.

The proportion who had their rectal cancer diagnosed by colonoscopy was higher in the areas of least deprivation (1-2) (68% compared with 55% in the highest deprivation quintile) (p=0.02) (Table 4.9-27).

There was little difference in the proportion with a synoptic pathology report, the number of lymph nodes examined or the number of positive lymph nodes by degree of deprivation (p-values of 0.9, 0.5 and 0.6 respectively) (Table 4.9-28, Table 4.9-29, Table 4.9-30). There was also little differences in the proportion with lymphovascular invasion (p=0.2) or the differentiation of the tumour (p=0.7) (Table 4.9-31, Table 4.9-32).

For patients presenting acutely, those living in areas of least deprivation (1-2) had a higher proportion who had a CT scan of the abdomen and pelvis (71%) compared to those in areas of higher deprivation (46-65%). There was no difference in the proportion having a CT scan of the abdomen and pelvis by level of deprivation for those not presenting acutely (Table 4.9-33).

The numbers of patients presenting acutely and having a CT scan of the chest were small, making comparisons by deprivation difficult. For patients presenting non-acutely there were no differences in proportions having a CT of the chest in the different deprivation quintiles (Table 4.9-34). The proportion having an MRI of the pelvis is reported only for patients presenting with non-metastatic disease. There was variation by deprivation in the proportions for patients presenting acutely, but the numbers were small. There was no variation by deprivation for the patients presenting non-acutely (Table 4.9-35).

Colonoscopy by 1 year and completeness of staging for patients with non-metastatic disease did not vary by deprivation of the area of residence at diagnosis (p=0.6 and 0.9 respectively) (Table 4.9-38). There was some variation in completeness of staging for patients with metastatic disease but the differences were not statistically significant (p=0.5) (Table 4.9-39).

Table 4.9-27 Method by which the initial diagnosis of rectal cancer was made by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Initial diagnosis method	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	172	68.3	150	62.8	162	65.9	140	60.1	107	54.9	731	62.7	0.02
Sigmoidoscopy	42	16.7	51	21.3	61	24.8	61	26.2	51	26.2	266	22.8	
Surgery	26	10.3	24	10.0	19	7.7	25	10.7	22	11.3	116	10.0	
CT	3	1.2	4	1.7	3	1.2	3	1.3	3	1.5	16	1.4	
Percutaneous biopsy	1	0.4	4	1.7	1	0.4	1	0.4	6	3.1	13	1.1	
MRI	1	0.4	3	1.3	0	0	0	0	3	1.5	7	0.6	
Luminal biopsy unknown instrument	1	0.4	2	0.8	0	0	2	0.9	1	0.5	6	0.5	
Other	0	0	1	0.4	0	0	0	0	0	0	1	0.1	
Barium enema	1	0.4	0	0	0	0	0	0	0	0	1	0.1	
Clinical	1	0.4	0	0	0	0	0	0	0	0	1	0.1	
Unknown	4	1.6	0	0	0	0	1	0.4	2	1.0	7	0.6	
Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0	

*p-value compares colonoscopy, sigmoidoscopy, surgery and other methods combined.

Table 4.9-28 Synoptic pathology report from surgery for resection of primary by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Synoptic pathology report	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	115	54.2	101	50.2	103	49.8	92	52.0	76	49.7	487	51.3	0.9
No	95	44.8	99	49.3	103	49.8	84	47.5	73	47.7	454	47.8	
Unknown	2	0.9	1	0.5	1	0.5	1	0.6	4	2.6	9	0.9	
Total	212	100.0	201	100.0	207	100.0	177	100.0	153	100.0	950	100.0	

Table 4.9-29 Number of lymph nodes examined at surgery for resection of primary by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

No. lymph nodes examined	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
<12 nodes	97	45.8	89	44.3	105	50.7	85	48.0	76	49.7	452	47.6	0.5
>=12 nodes	112	52.8	106	52.7	93	44.9	85	48.0	71	46.4	467	49.2	
Unknown	3	1.4	6	3.0	9	4.3	7	4.0	6	3.9	31	3.3	
Total	212	100.0	201	100.0	207	100.0	177	100.0	153	100.0	950	100.0	

Table 4.9-30 Number of positive lymph nodes by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

No. positive lymph nodes	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
0	117	55.2	111	55.2	105	50.7	84	47.5	78	51.0	495	52.1	0.6
1-3	50	23.6	41	20.4	54	26.1	47	26.6	35	22.9	227	23.9	
4-12	34	16.0	26	12.9	18	8.7	23	13.0	19	12.4	120	12.6	
>12	3	1.4	7	3.5	2	1.0	4	2.3	3	2.0	19	2.0	
Unknown	8	3.8	16	8.0	28	13.5	19	10.7	18	11.8	89	9.4	
Total	212	100.0	201	100.0	207	100.0	177	100.0	153	100.0	950	100.0	

Table 4.9-31 Lymphovascular space invasion by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Lymphovascular invasion	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	41	19.3	42	20.9	45	21.7	44	24.9	42	27.5	214	22.5	0.2
No	138	65.1	128	63.7	121	58.5	100	56.5	84	54.9	571	60.1	
Unknown	33	15.6	31	15.4	41	19.8	33	18.6	27	17.6	165	17.4	
Total	212	100.0	201	100.0	207	100.0	177	100.0	153	100.0	950	100.0	

Table 4.9-32 Differentiation of the tumour by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Differentiation	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Well	32	15.1	33	16.4	33	15.9	26	14.7	32	20.9	156	16.4	0.7
Moderate	117	55.2	98	48.8	113	54.6	86	48.6	77	50.3	491	51.7	
Poor	21	9.9	20	10.0	18	8.7	26	14.7	20	13.1	105	11.1	
Undifferentiated	2	0.9	4	2.0	5	2.4	2	1.1	3	2.0	16	1.7	
Unknown	40	18.9	46	22.9	38	18.4	37	20.9	21	13.7	182	19.2	
Total	212	100.0	201	100.0	207	100.0	177	100.0	153	100.0	950	100.0	

Table 4.9-33 CT scan of the abdomen and pelvis by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

CT abdo/pelvis within 8 weeks		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT abdomen/pelvis**												
Yes	**Within 8 weeks before first treatment**	22	71.0	20	57.1	21	65.6	19	46.3	15	51.7	97	8.3
	Within 8 weeks after first treatment	2	6.5	3	8.6	3	9.4	1	2.4	1	3.4	10	0.9
	None within 8 weeks of first treatment	4	12.9	4	11.4	1	3.1	7	17.1	5	17.2	21	1.8
	Unknown or no treatment	3	9.7	8	22.9	7	21.9	14	34.1	8	27.6	40	3.4
	Total	31	100.0	35	100.0	32	100.0	41	100.0	29	100.0	168	14.4
No	**CT abdomen/pelvis**												
	Within 8 weeks before first treatment	147	72.1	138	70.8	143	71.5	130	68.8	113	70.2	671	57.6
	Within 8 weeks after first treatment	7	3.4	6	3.1	4	2.0	10	5.3	7	4.3	34	2.9
	None within 8 weeks of first treatment	37	18.1	44	22.6	42	21.0	36	19.0	27	16.8	186	16.0
	Unknown or no treatment	13	6.4	7	3.6	11	5.5	13	6.9	14	8.7	58	5.0
	Total	204	100.0	195	100.0	200	100.0	189	100.0	161	100.0	949	81.5
Unknown	**CT abdomen/pelvis**												
	Within 8 weeks before first treatment	10	58.8	6	66.7	10	71.4	3	100.0	1	20.0	30	2.6
	Within 8 weeks after first treatment	1	5.9	0	0	1	7.1	0	0	1	20.0	3	0.3
	None within 8 weeks of first treatment	6	35.3	3	33.3	3	21.4	0	0	3	60.0	15	1.3
	Total	17	100.0	9	100.0	14	100.0	3	100.0	5	100.0	48	4.1
	Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0

Table 4.9-34 CT scan of the chest by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Ct chest within 8 weeks		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**CT chest**												
Yes	**Within 8 weeks before first treatment**	12	38.7	7	20.0	16	50.0	15	36.6	11	37.9	61	5.2
	Within 8 weeks after first treatment	2	6.5	2	5.7	0	0	0	0	0	0	4	0.3
	None within 8 weeks of first treatment	14	45.2	18	51.4	9	28.1	12	29.3	10	34.5	63	5.4
	Unknown or no treatment	3	9.7	8	22.9	7	21.9	14	34.1	8	27.6	40	3.4
	Total	31	100.0	35	100.0	32	100.0	41	100.0	29	100.0	168	14.4
No	**CT chest**												
	Within 8 weeks before first treatment	100	49.0	89	45.6	96	48.0	94	49.7	77	47.8	456	39.1
	Within 8 weeks after first treatment	4	2.0	4	2.1	4	2.0	8	4.2	10	6.2	30	2.6
	None within 8 weeks of first treatment	87	42.6	95	48.7	89	44.5	74	39.2	60	37.3	405	34.8
	Unknown or no treatment	13	6.4	7	3.6	11	5.5	13	6.9	14	8.7	58	5.0
	Total	204	100.0	195	100.0	200	100.0	189	100.0	161	100.0	949	81.5
Unknown	**CT chest**												
	Within 8 weeks before first treatment	8	47.1	5	55.6	9	64.3	2	66.7	1	20.0	25	2.1
	Within 8 weeks after first treatment	1	5.9	0	0	0	0	0	0	1	20.0	2	0.2
	None within 8 weeks of first treatment	8	47.1	4	44.4	5	35.7	1	33.3	3	60.0	21	1.8
	Total	17	100.0	9	100.0	14	100.0	3	100.0	5	100.0	48	4.1
	Total	252	100.0	239	100.0	246	100.0	233	100.0	195	100.0	1165	100.0

Table 4.9-35 MRI of the pelvis by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

MRI within 8 weeks (Stage I-III only)		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
Acute presentation	**MRI of pelvis**												
Yes	**Within 8 weeks before first treatment**	17	65.4	12	42.9	10	40.0	14	56.0	10	58.8	63	7.0
	Within 8 weeks after first treatment	0	0	0	0	1	4.0	1	4.0	1	5.9	3	0.3
	None within 8 weeks of first treatment	7	26.9	11	39.3	10	40.0	5	20.0	4	23.5	37	4.1
	Unknown	2	7.7	5	17.9	4	16.0	5	20.0	2	11.8	18	2.0
	Total	26	100.0	28	100.0	25	100.0	25	100.0	17	100.0	121	13.4
No	**MRI of pelvis**												
	Within 8 weeks before first treatment	90	60.4	105	64.8	88	54.0	86	58.5	71	59.7	440	48.7
	Within 8 weeks after first treatment	1	0.7	3	1.9	0	0	0	0	2	1.7	6	0.7
	None within 8 weeks of first treatment	54	36.2	51	31.5	70	42.9	56	38.1	41	34.5	272	30.1
	Unknown	4	2.7	3	1.9	5	3.1	5	3.4	5	4.2	22	2.4
	Total	149	100.0	162	100.0	163	100.0	147	100.0	119	100.0	740	81.9
Unknown	**MRI of pelvis**												
	Within 8 weeks before first treatment	5	33.3	2	28.6	5	41.7	1	33.3	2	40.0	15	1.7
	None within 8 weeks of first treatment	10	66.7	5	71.4	7	58.3	2	66.7	3	60.0	27	3.0
	Total	15	100.0	7	100.0	12	100.0	3	100.0	5	100.0	42	4.7
	Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	903	100.0

Table 4.9-36 Disease outcomes by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Alive and disease free at 1 year	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
No treatment date*	1	0.5	0	0	0	0	1	0.6	0	0	2	0.2	0.2
Sill alive and progression free	116	63.4	115	65.3	114	61.3	84	54.2	65	51.2	494	59.7	
Progressed or died within a year	18	9.8	21	11.9	17	9.1	20	12.9	18	14.2	94	11.4	
Progressed or died after 1yr	48	26.2	40	22.7	55	29.6	50	32.3	44	34.6	237	28.7	
Total	183	100.0	176	100.0	186	100.0	155	100.0	127	100.0	827	100.0	

*Date of first treatment is unknown

Table 4.9-37 Colonoscopy within 1 year of initial treatment for patients who were still alive and progression free at 1 year by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Colonoscopy within 1 year	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	96	58.5	94	60.6	113	66.9	80	59.7	69	63.3	452	61.8	0.6
No	68	41.5	61	39.4	56	33.1	54	40.3	40	36.7	279	38.2	
Total	164	100.0	155	100.0	169	100.0	134	100.0	109	100.0	731	100.0	

Table 4.9-38 Completeness of staging at diagnosis for patients with non-metastatic rectal cancer who were alive and disease free at 1 year by area deprivation score for residence at the time of diagnosis

Completeness of staging	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	49	29.9	53	34.2	51	30.2	42	31.3	37	33.9	232	31.7	0.9
No	115	70.1	102	65.8	118	69.8	92	68.7	72	66.1	499	68.3	
Total	164	100.0	155	100.0	169	100.0	134	100.0	109	100.0	731	100.0	

Table 4.9-39 Completeness of staging at diagnosis for patients with metastatic rectal cancer who were alive and disease free at 1 year by area deprivation score for residence at the time of diagnosis

Completeness of staging	Deprivation index 2006												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	25	59.5	14	48.3	22	71.0	22	61.1	18	56.3	101	59.4	0.5
No	17	40.5	15	51.7	9	29.0	14	38.9	14	43.8	69	40.6	
Total	42	100.0	29	100.0	31	100.0	36	100.0	32	100.0	170	100.0	

4.9.5 Ethnicity for rectal cancer

There were 1396 patients in the extended PIPER cohort diagnosed with rectal cancer in the years 2006-2009. Of these 1392 had known ethnicity. For Pacific patients the proportion diagnosed by colonoscopy was 72%, compared with 60% for Māori and 62% for nMnP, but the differences were not statistically significant (p=0.2) (Table 4.9-40).

The proportion of Māori patients with a synoptic pathology report was 33%, whereas for Pacific patients it was 54% and for nMnP it was 51% (p=0.004) (Table 4.9-1). The group of Māori patients also had fewer lymph nodes examined (37%) compared with 61% for Pacific patients and 51% for nMnP patients (p=0.009) (Table 4.9-42). The proportion of patients with one or more positive nodes did not differ by ethnicity (p=0.8), although the comparison is not reliable as the groups had different numbers of nodes examined (Table 4.9-43). The Pacific patient group had a higher proportion with lymphovascular space invasion (39% vs. 21% for Māori and 22% for nMnP, p=0.03) (Table 4.9-44). The proportions of the different types of cell differentiation were similar in the three ethnic groups (p=0.5) (Table 4.9-45).

The numbers of Māori and Pacific patients who presented acutely was small, so the estimates of the proportions of patients who had the appropriate imaging in these groups are unreliable. For patients presenting non-acutely the proportions who had a CT scan of the abdomen and pelvis were similar in the 3 ethnic groups (Table 4.9-46), but the proportion who had a CT scan of the chest was 73% for Pacific patients, 52% for Māori patients and 47% for nMnP (Table 4.9-47).

The proportions with a colonoscopy by one year, and of those with complete staging were similar in the Māori, Pacific and nMnP groups (Table 4.9-50, Table 4.9-51, Table 4.9-52).

Table 4.9-40 Method by which the initial diagnosis of rectal cancer was made by prioritised ethnicity for patients with rectal cancer

Initial diagnosis method	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Colonoscopy	81	59.6	42	72.4	737	61.5	860	61.8	0.2
Sigmoidoscopy	34	25.0	6	10.3	275	23.0	315	22.6	
Surgery	16	11.8	3	5.2	120	10.0	139	10.0	
CT	1	0.7	1	1.7	20	1.7	22	1.6	
Percutaneous biopsy	3	2.2	1	1.7	14	1.2	18	1.3	
MRI	0	0	1	1.7	6	0.5	7	0.5	
Luminal biopsy unknown instrument	1	0.7	1	1.7	11	0.9	13	0.9	
Other	0	0	0	0	2	0.2	2	0.1	
Barium enema	0	0	0	0	1	0.1	1	0.1	
Clinical	0	0	1	1.7	2	0.2	3	0.2	
Laparoscopy	0	0	1	1.7	2	0.2	3	0.2	
Unknown	0	0	1	1.7	8	0.7	9	0.6	
Total	136	100.0	58	100.0	1198	100.0	1392	100.0	

Table 4.9-41 Synoptic pathology report from surgery for resection of primary by prioritised ethnicity for patients with rectal cancer

Synoptic pathology report	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	34	33.0	22	53.7	501	51.2	557	49.6	0.004
No	65	63.1	17	41.5	472	48.3	554	49.4	
Unknown	4	3.9	2	4.9	5	0.5	11	1.0	
Total	103	100.0	41	100.0	978	100.0	1122	100.0	

Table 4.9-42 Number of lymph nodes examined at surgery for resection of primary by prioritised ethnicity for patients with rectal cancer

No. lymph nodes examined	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
<12 nodes	61	59.2	14	34.1	453	46.3	528	47.1	0.009
>=12 nodes	38	36.9	25	61.0	495	50.6	558	49.7	
Unknown	4	3.9	2	4.9	30	3.1	36	3.2	
Total	103	100.0	41	100.0	978	100.0	1122	100.0	

Table 4.9-43 Number of positive lymph nodes by prioritised ethnicity for patients with rectal cancer

No. positive lymph nodes	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
0	49	47.6	13	31.7	536	54.7	598	53.3	0.8
1-3	26	25.2	13	31.7	240	24.5	279	24.8	
4-12	17	16.5	9	22.0	121	12.4	147	13.1	
>12	2	1.9	1	2.4	17	1.7	20	1.8	
Unknown	9	8.7	5	12.2	65	6.6	79	7.0	
Total	103	100.0	41	100.0	979	100.0	1123	100.0	

Table 4.9-44 Lymphovascular space invasion by prioritised ethnicity for patients with rectal cancer

Lymphovascular invasion	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	22	21.4	16	39.0	216	22.1	254	22.6	0.03
No	51	49.5	18	43.9	595	60.8	664	59.2	
Unknown	30	29.1	7	17.1	167	17.1	204	18.2	
Total	103	100.0	41	100.0	978	100.0	1122	100.0	

Table 4.9-45 Differentiation of the tumour by prioritised ethnicity for patients with rectal cancer

Differentiation	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Well	17	16.5	8	19.5	161	16.5	186	16.6	0.5
Moderate	57	55.3	22	53.7	511	52.2	590	52.6	
Poor	7	6.8	7	17.1	107	10.9	121	10.8	
Undifferentiated	3	2.9	2	4.9	17	1.7	22	2.0	
Unknown	14	13.6	2	4.9	152	15.5	168	15.0	
Not applicable	5	4.9	0	0	30	3.1	35	3.1	
Total	103	100.0	41	100.0	978	100.0	1122	100.0	

Table 4.9-46 CT scan of the abdomen and pelvis by prioritised ethnicity for patients with rectal cancer

CT abdo/pelvis within 8 weeks		Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of abdomen and pelvis**								
Yes	**Within 8 weeks before first treatment**	16	57.1	6	42.9	93	59.2	115	8.3
	Within 8 weeks after first treatment	0	0	1	7.1	10	6.4	11	0.8
	None within 8 weeks of first treatment	7	25.0	3	21.4	16	10.2	26	1.9
	Unknown	5	17.9	4	28.6	38	24.2	47	3.4
	Total	28	100.0	14	100.0	157	100.0	199	14.3
No	**CT of abdomen and pelvis**								
	Within 8 weeks before first treatment	67	69.1	30	73.2	686	70.9	783	56.3
	Within 8 weeks after first treatment	6	6.2	6	14.6	27	2.8	39	2.8
	None within 8 weeks of first treatment	17	17.5	2	4.9	193	19.9	212	15.2
	Unknown	7	7.2	3	7.3	62	6.4	72	5.2
	Total	97	100.0	41	100.0	968	100.0	1106	79.5
Unknown	**CT of abdomen and pelvis**								
	Within 8 weeks before first treatment	6	54.5	1	33.3	35	47.9	42	3.0
	Within 8 weeks after first treatment	2	18.2	0	0	6	8.2	8	0.6
	None within 8 weeks of first treatment	2	18.2	0	0	25	34.2	27	1.9
	Unknown	1	9.1	2	66.7	7	9.6	10	0.7
	Total	11	100.0	3	100.0	73	100.0	87	6.3
	Total	136	100.0	58	100.0	1198	100.0	1392	100.0

Table 4.9-47 CT scan of the chest by prioritised ethnicity for patients with rectal cancer

CT scan of chest within 8 weeks		Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
Acute presentation	**CT of chest**								
Yes	**Within 8 weeks before first treatment**	13	46.4	7	50.0	58	36.9	78	5.6
	Within 8 weeks after first treatment	0	0	0	0	4	2.5	4	0.3
	None within 8 weeks of first treatment	10	35.7	3	21.4	57	36.3	70	5.0
	Unknown or no treatment	5	17.9	4	28.6	38	24.2	47	3.4
	Total	28	100.0	14	100.0	157	100.0	199	14.3
No	**CT of chest**								
	Within 8 weeks before first treatment	51	52.6	30	73.2	458	47.3	539	38.7
	Within 8 weeks after first treatment	6	6.2	4	9.8	25	2.6	35	2.5
	None within 8 weeks of first treatment	33	34.0	4	9.8	423	43.7	460	33.0
	Unknown or no treatment	7	7.2	3	7.3	62	6.4	72	5.2
	Total	97	100.0	41	100.0	968	100.0	1106	79.5
Unknown	**CT of chest**								
	Within 8 weeks before first treatment	6	54.5	1	33.3	30	41.1	37	2.7
	Within 8 weeks after first treatment	1	9.1	0	0	3	4.1	4	0.3
	None within 8 weeks of first treatment	3	27.3	0	0	33	45.2	36	2.6
	Unknown or no treatment	1	9.1	2	66.7	7	9.6	10	0.7
	Total	11	100.0	3	100.0	73	100.0	87	6.3
	Total	136	100.0	58	100.0	1198	100.0	1392	100.0

Table 4.9-48 MRI of the pelvis by prioritised ethnicity for patients with non-metastatic rectal cancer

	MRI within 8 weeks (non-metastatic only)	Prioritised Ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
Acute presentation	**MRI of pelvis**								
Yes	**Within 8 weeks before first treatment**	12	85.7	3	37.5	58	50.9	73	6.9
	Within 8 weeks after first treatment	0	0	0	0	3	2.6	3	0.3
	None within 8 weeks of first treatment	2	14.3	4	50.0	36	31.6	42	4.0
	Unknown	0	0	1	12.5	17	14.9	18	1.7
	Total	14	100.0	8	100.0	114	100.0	136	12.8
No	**MRI of pelvis**								
	Within 8 weeks before first treatment	43	62.3	15	46.9	456	60.2	514	48.5
	Within 8 weeks after first treatment	0	0	0	0	7	0.9	7	0.7
	None within 8 weeks of first treatment	23	33.3	15	46.9	271	35.8	309	29.2
	Unknown	3	4.3	2	6.3	24	3.2	29	2.7
	Total	69	100.0	32	100.0	758	100.0	859	81.1
Unknown	**MRI of pelvis**								
	Within 8 weeks before first treatment	3	37.5	1	50.0	21	38.9	25	2.4
	None within 8 weeks of first treatment	5	62.5	0	0	32	59.3	37	3.5
	Unknown	0	0	1	50.0	1	1.9	2	0.2
	Total	8	100.0	2	100.0	54	100.0	64	6.0
	Total	91	100.0	42	100.0	926	100.0	1059	100.0

Table 4.9-49 Disease outcomes by prioritised ethnicity for patients with rectal cancer

Alive and disease free at 1 year	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
No treatment date*	0	0	0	0	3	0.4	3	0.3	0.6
Sill alive and progression free	53	60.9	16	47.1	507	59.9	576	59.6	
Progressed or died within a year	10	11.5	4	11.8	97	11.5	111	11.5	
Progressed or died after 1yr	24	27.6	14	41.2	239	28.3	277	28.6	
Total	87	100.0	34	100.0	846	100.0	967	100.0	

*Date of first treatment is unknown

Table 4.9-50 Colonoscopy within 1 year of initial treatment for patients who were still alive and progression free at 1 year by prioritised ethnicity for patients with rectal cancer

Colonoscopy within 1 year	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	41	53.2	19	63.3	461	61.8	521	61.1	0.3
No	36	46.8	11	36.7	285	38.2	332	38.9	
Total	77	100.0	30	100.0	746	100.0	853	100.0	

Table 4.9-51 Completeness of staging at diagnosis for patients with stage I-III rectal cancer who were alive and disease free at 1 year by prioritised ethnicity for patients with rectal cancer

Completeness of staging (non-metastatic)	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	25	32.5	7	23.3	236	31.6	268	31.4	0.8
No	52	67.5	23	76.7	510	68.4	585	68.6	
Total	77	100.0	30	100.0	746	100.0	853	100.0	

Table 4.9-52 Completeness of staging at diagnosis for patients with stage IV rectal cancer who were alive and disease free at 1 year by prioritised ethnicity for patients with rectal cancer

Completeness of staging (Metastatic)	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	20	64.5	6	60.0	96	57.5	122	58.7	0.96
No	11	35.5	4	40.0	71	42.5	86	41.3	
Total	31	100.0	10	100.0	167	100.0	208	100.0	

4.9.6 Key points: staging for rectal cancer

Pathological diagnosis of rectal cancer:

- 63% of patients achieved pathological diagnosis at colonoscopy with a further 22% of patients achieving this at sigmoidoscopy. 10% of patients had cancer pathologically confirmed for the first time at surgery.
- Independent urban patients were slightly more likely to be initially diagnosed via sigmoidoscopy (31%) compared to urban (21%); those with the highest deprivation scores were also most likely to be diagnosed via sigmoidoscopy compared to those with lowest deprivation score (dep 9-10: 26%; decile 1-2: 17%). No particular trend was seen for ethnicity.
- Less than 2% were diagnosed by imaging only without further pathology being obtained.

Synoptic pathology reporting:

- Of those with a primary tumour resected and pathology report available (not polypectomy) 51% of patients had a synoptic report, which is slightly lower than for colon cancer.
- Synoptic reports were more common in urban patients than rural (54% v 50%) but least common in independent urban (43%; p=0.04)
- Māori were least likely to have a synoptic report (33%; Pacific 54% nMnP 51%; p=0.004. No particular patterns were seen by rurality or distance to health facility of diagnosis.

Lymph node examination:

- Māori were more likely to have fewer than 12 lymph nodes examined, but were also more likely to have received pre-op radiotherapy
- 59% of Māori had fewer than 12 nodes examined compared to 34% Pacific and 46% nMnP; p=0.009. This may reflect the finding noted in the neo-adjuvant section that showed Māori were slightly more likely to receive radiotherapy (63%) compared to Pacific (43%) or nMnP (53%)

- Rural patients were more likely to have received radiotherapy than independent urban patients, however independent-urban patients had a higher proportion with fewer than 12 nodes examined (58% v 51%).

CT staging scans:

- 19% of patients did not undergo a CT of the abdo/pelvis at any time in their journey. Due to the complexities of defining stage in rectal cancer, this proportion is not able to be clarified further by stage
- Patients presenting non-acutely were less likely to undergo a CT of the abdo/pelvis than those presently acutely, although this is likely to be due to disease characteristics
- Independent urban patients were less likely to be completely staged (see 3.2.4.3in the methods section) than urban or rural patients (42% v 51% and 47% respectively)

Colonoscopy:

- 38% of patients did not have completion colonoscopy within one year.
- Rural, and Māori patients were least likely to undergo completion colonoscopy (both had 54% with complete colonoscopy within 1 year)
- There was no particular pattern according to deprivation score or distance to health facility of diagnosis.

4.9.7 Discussion: staging for rectal cancer

Staging and management of rectal cancer is complex and requires multi-disciplinary input. Many radiological examinations and staging investigations are considered to be stage specific. For example, villous adenomas of the rectum that harbour microscopic invasion of the stalk require different considerations than bulky T4 tumours with invasion of adjacent organs.

Staging is important for diagnostic, prognostic, and therapeutic purposes. Given the broad array of possible presentations it can be difficult to mandate a set of staging procedures for EVERY rectal cancer.

The NZGG Management of early CRC guideline recommended that every rectal cancer be fully-staged with CT of the chest, abdomen and pelvis, and no distinction is made between T1 and T4 tumours in their need for CT staging. It is therefore of interest to see that 19% of patients undergo no CT staging at all at any time of their journey.

The proportion of patients having pathology reported synoptically was only 51% in this cohort. Whilst this is likely to have risen, it remains of concern. The definition of "synoptic report" varies between organisations and individuals. We defined "synoptic report" as a report that was structured, and that included the key pathological information of T stage, number of involved nodes and total node harvest, presence or absence of lymphatic and vascular invasion, degree of differentiation of the tumour (grade), and comment on all relevant margins (in rectal this had to include proximal, distal and circumferential).

What is also surprising is that there is a difference by ethnicity of synoptic reporting. The reasons for this are not immediately apparent, but may reflect the nature of health care services provided to Māori and that these facilities may be less likely to use synoptic reporting. Synoptic reporting may be a surrogate for quality of pathology reporting systems. It is also of interest that Māori are also most likely to have fewer than12 nodes examined, which puts them at higher risk of being under-staged and therefore being under-treated. Whilst Māori are more likely to receive pre-operative chemoradiation which is known to reduce lymph node counts and may be a mediator in this finding, other single institution series have noted that in those treated with chemoradiation, 46% have fewer than 12 nodes examined. This suggests that Māori are having lower nodal examination than elsewhere. It may be that the lower rates of synoptic reporting and lower nodal counts are related to quality of pathology reporting, and this may be one area for focus on quality reporting.

Recently, the Ministry of Health has introduced reporting requirements for colonoscopy, including reporting on wait times to colonoscopy by category of urgency. Additionally, much recent work has focused on prioritising faster cancer treatment which inevitably puts greater emphasis on diagnostic wait times than surveillance wait times. Several international guidelines recommend complete colonoscopy (or complete colonic evaluation utilising CT Colonography) prior to resection. Where this is not possible, the NZGG recommends that complete colonic evaluation be undertaken within 12 months of surgery. Our data shows that 38% of patients with resected non-metastatic rectal cancer are not achieving this recommendation. This may represent a gap in service provision that could be monitored for improvement.

Highlights: Rectal Cancer

Staging

10% of patients with rectal cancer had pathology confirmed for the first time at surgery

Fewer than half the pathology reports reported that 12 or more lymph nodes were examined

51% of pathology reports were in synoptic form for rectal cancer

38% of patients had not had complete colonoscopy within a year of diagnosis

32% of patients presenting with non-metastatic disease and 59% of those presenting with metastatic disease underwent complete staging with colonoscopy, CT of the abdomen and pelvis and MRI

4.10 Rectal Cancer: Treatment

4.10.1 Cohort of patients with non-metastatic rectal cancer

The analysis in this section is for all cases from the main PIPER cohort (diagnosed in 2007 or 2008) with the site of the primary tumour being rectum and the clinical pre-operative stage non-metastatic (referring to localised and regionally advanced for rectal patients). Of the 1203 patients diagnosed with rectal cancer there were 924 patients with non-metastatic rectal cancer (76% of all rectal cases diagnosed 2007-2008).

Table 4.10-1-Table 4.10-9 outline the age, gender and co-morbidity distributions for this cohort by rurality of residence at diagnosis, distance from residence to diagnosis facility and NZ deprivation score. The rural group of patients appear to have a younger age distribution, a higher proportion of males and a lower co-morbidity score than the urban and independent-urban groups. There are no obvious patterns in the distance from residence to diagnosis facility (Table 4.10-4-Table 4.10-6). The proportion of females appears to increase with deprivation as does the comorbidity scores (Table 4.10-7-Table 4.10-9).

Table 4.10-1 Age at diagnosis by rurality of residence at the time of diagnosis for patients with rectal cancer

	Rurality of residence at time of diagnosis									
Age at diagnosis	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	16	2.5	0	0	1	0.9	0	0	17	1.8
>40-50	32	5.0	6	3.9	17	14.5	3	20.0	58	6.3
>50-60	89	13.9	17	11.1	23	19.7	5	33.3	134	14.5
>60-70	175	27.4	51	33.3	40	34.2	3	20.0	269	29.1
>70-80	196	30.7	42	27.5	23	19.7	3	20.0	264	28.6
>/=80	131	20.5	37	24.2	13	11.1	1	6.7	182	19.7
Total	639	100.0	153	100.0	117	100.0	15	100.0	924	100.0

Table 4.10-2 Gender by rurality of residence at the time of diagnosis for patients with rectal cancer

Gender	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	237	37.1	67	43.8	43	36.8	3	20.0	350	37.9
Male	402	62.9	86	56.2	74	63.2	12	80.0	574	62.1
Total	639	100.0	153	100.0	117	100.0	15	100.0	924	100.0

Table 4.10-3 C3 Comorbidity score by rurality of residence at the time of diagnosis for patients with rectal cancer

C3 comorbidity score	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	388	60.7	89	58.2	83	70.9	12	80.0	572	61.9
0-<1	84	13.1	19	12.4	13	11.1	2	13.3	118	12.8
1-<2	68	10.6	19	12.4	11	9.4	1	6.7	99	10.7
>2	99	15.5	26	17.0	10	8.5	0	0	135	14.6
Total	639	100.0	153	100.0	117	100.0	15	100.0	924	100.0

Table 4.10-4 Age at diagnosis by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with rectal cancer

Age at diagnosis	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	8	2.5	4	2.3	3	2.1	2	1.2	0	0	0	0	17	1.8
>40-50	14	4.3	9	5.2	11	7.7	10	5.9	11	11.6	3	15.0	58	6.3
>50-60	49	15.1	27	15.7	19	13.3	22	13.0	10	10.5	7	35.0	134	14.5
>60-70	85	26.2	47	27.3	43	30.1	60	35.5	29	30.5	5	25.0	269	29.1
>70-80	101	31.1	46	26.7	44	30.8	45	26.6	25	26.3	3	15.0	264	28.6
>80	68	20.9	39	22.7	23	16.1	30	17.8	20	21.1	2	10.0	182	19.7
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	20	100.0	924	100.0

Table 4.10-5 Gender by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with rectal cancer

Gender	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Female	136	41.8	66	38.4	45	31.5	59	34.9	38	40.0	6	30.0	350	37.9
Male	189	58.2	106	61.6	98	68.5	110	65.1	57	60.0	14	70.0	574	62.1
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	20	100.0	924	100.0

Table 4.10-6 Comorbidity score by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with rectal cancer

C3 comorbidity score	Distance from residence to facility of diagnosis													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
0	191	58.8	106	61.6	96	67.1	107	63.3	56	58.9	16	80.0	572	61.9
>0-<1	45	13.8	24	14.0	14	9.8	21	12.4	12	12.6	2	10.0	118	12.8
1-<2	36	11.1	21	12.2	16	11.2	15	8.9	10	10.5	1	5.0	99	10.7
>2	53	16.3	21	12.2	17	11.9	26	15.4	17	17.9	1	5.0	135	14.6
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	20	100.0	924	100.0

Table 4.10-7 Age at diagnosis by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

Age at diagnosis	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	3	1.6	4	2.0	4	2.0	3	1.7	3	2.1	0	0	17	1.8
>40-50	16	8.4	10	5.1	11	5.5	6	3.4	12	8.5	3	14.3	58	6.3
>50-60	32	16.8	36	18.3	24	12.0	21	12.0	16	11.3	5	23.8	134	14.5
>60-70	62	32.6	52	26.4	55	27.5	53	30.3	43	30.5	4	19.0	269	29.1
>70-80	50	26.3	49	24.9	68	34.0	56	32.0	37	26.2	4	19.0	264	28.6
>/=80	27	14.2	46	23.4	38	19.0	36	20.6	30	21.3	5	23.8	182	19.7
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	21	100.0	924	100.0

Table 4.10-8 Gender by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

	NZ Deprivation Index of residence at time of diagnosis													
Gender	**1-2**		**3-4**		**5-6**		**7-8**		**9-10**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
Female	66	34.7	73	37.1	77	38.5	71	40.6	58	41.1	5	23.8	350	37.9
Male	124	65.3	124	62.9	123	61.5	104	59.4	83	58.9	16	76.2	574	62.1
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	21	100.0	924	100.0

Table 4.10-9 C3 Comorbidity score by area deprivation score for residence at the time of diagnosis for patients with rectal cancer

	NZ Deprivation Index of residence at time of diagnosis													
C3 comorbidity score	**1-2**		**3-4**		**5-6**		**7-8**		**9-10**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
0	132	69.5	131	66.5	120	60.0	95	54.3	76	53.9	18	85.7	572	61.9
0-<1	23	12.1	28	14.2	22	11.0	21	12.0	22	15.6	2	9.5	118	12.8
1-<2	16	8.4	18	9.1	27	13.5	23	13.1	14	9.9	1	4.8	99	10.7
>2	19	10.0	20	10.2	31	15.5	36	20.6	29	20.6	0	0	135	14.6
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	21	100.0	924	100.0

To evaluate ethnicity the extended PIPER cohort was used (all patients in the main cohort plus all Māori and Pacific patients diagnosed in the calendar years 1 January 2006 – 31 Dec 2006 and 1 Jan 2009 – 31 Dec 2009 and a randomly sampled equal number of nMnP patients). For non-metastatic rectal patients there were an additional 139 patients diagnosed in 2006 and 2009 included in the analysis, giving a total of 1063 patients with non-metastatic rectal cancer.

Table 4.10-10-Table 4.10-12 show the age, gender and co-morbidity distributions for this cohort by ethnicity. The Māori and the Pacific patient group are younger than the nMnP group, with the Pacific patient group being the youngest. Māori and Pacific patient groups tend to have higher co-morbidity scores.

Table 4.10-10 Age at diagnosis by prioritised ethnicity for patients with rectal cancer

Age at diagnosis	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	2	2.2	8	19.0	12	1.3	0	0	22	2.1
>40-50	12	13.2	3	7.1	57	6.2	0	0	72	6.8
>50-60	20	22.0	5	11.9	136	14.7	1	25.0	162	15.2
>60-70	35	38.5	16	38.1	263	28.4	1	25.0	315	29.6
>70-80	19	20.9	7	16.7	278	30.0	1	25.0	305	28.7
>80	3	3.3	3	7.1	180	19.4	1	25.0	187	17.6
Total	91	100.0	42	100.0	926	100.0	4	100.0	1063	100.0

Table 4.10-11 Gender by prioritised ethnicity for patients with rectal cancer

Gender	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	33	36.3	15	35.7	348	37.6	2	50.0	398	37.4
Male	58	63.7	27	64.3	578	62.4	2	50.0	665	62.6
Total	91	100.0	42	100.0	926	100.0	4	100.0	1063	100.0

Table 4.10-12 C3 Comorbidity score by prioritised ethnicity for patients with rectal cancer

C3 comorbidity score	Prioritised ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	51	56.0	22	52.4	575	62.1	3	75.0	651	61.2
0-<1	11	12.1	6	14.3	118	12.7	1	25.0	136	12.8
1-<2	9	9.9	6	14.3	103	11.1	0	0	118	11.1
>2	20	22.0	8	19.0	130	14.0	0	0	158	14.9
Total	91	100.0	42	100.0	926	100.0	4	100.0	1063	100.0

4.10.2 Non-metastatic rectal cancer: surgical treatment

The patient's pre-operative staging was used to define stage the surgical treatment of non-metastatic rectal cancer. There were 924 patients with non-metastatic rectal cancer in the main PIPER cohort (diagnosed in 2007 and 2008),and 1063 in the extended PIPER cohort (diagnosed in 2006-2009).

4.10.2.1 KPIs for surgical treatment for non-metastatic rectal cancer

The key performance indicators used for describing the surgical treatment of rectal cancer in this section are:

- Percentage of patients with the primary excised
- Description of surgical procedure
- Percentage with complete excision of primary tumour (R0 resection)
- Percentage with distance of tumour to circumferential resection margin reported on pathology report
- Percentage with quality of mesorectum reported on pathology report
- Length of post-operative stay
- Percentage of patients requiring re-operation
- Anastomotic leak rate as a percentage of patients having an anastomosis
- 30 day mortality post–operative mortality
- 90 day mortality post–operative mortality
- Post-operative medical complications
- Experience of surgeon (number of colorectal surgeries per year)
- Whether pre-operative TNM stage available

The KPIs chosen assess the quality of rectal cancer surgical care available to New Zealanders over the study period. The percentage of rectal cancers excised reflects the stage at diagnosis, the co-morbidity of patients as well as the service provision of CRC surgery.

It has long been recognised that macroscopic pathological assessment of the quality of the rectal cancer specimen after total mesorectal excision (TME) is an accurate predictor of the rate of local recurrence but also survival after rectal cancer surgery.[68]

Quality of surgery is also assessed by the rate of return to theatre,[51, 69, 70] the anastomotic leak rate[53] and the 30 and 90 day mortality.[42, 71, 72] There is an association between rates of local recurrence and anastomotic leak as both assess the quality of rectal cancer surgery.[73] Significant differences have been found between surgeons in many of these outcome measures in previous studies.[74] Cardiorespiratory deaths account the majority of the post-operative deaths after elective rectal cancer surgery and so are a useful measure of the quality of the medical assessment and perioperative care of patients in the surgical service.

4.10.2.2 Rurality of residence at diagnosis for rectal cancer

Of the 924 patients with non-metastatic rectal cancer, 15 had unknown rurality status, leaving 909 patients for analysis in this section.

Overall 92% (95% CI:90 to 93) of patients with non-metastatic cancer had their primary removed (Table 4.10-13). The proportions were similar between the groups (93% for rural, 92% for independent urban and 91% for urban, p=0.8).

The main operations performed for the removal of the primary are listed in Table 4.10-14. Twenty-three patients had 2 operations and 1 patient had 3 operations for the removal of the primary. A main operation for the removal of primary was ascertained based on the operations performed and the timing of the operation by one of the PIPER surgeons.

Overall, low/ultra-low AR was the most frequent operation performed to remove the primary tumour in non-metastatic rectal cancer (45%, 95% CI:42 to 48) (Table 4.10-14). Four percent of patients had their primary removed via an anorectal procedure only. There were some differences in the operations for the rural groups, the most notable difference being for low/ultra-low AR (rural 50%; urban 45%; independent urban 40%). However these differences could be partially be due to differences in the urban/rural populations, such as differences in age, gender, level of comorbidity and disease stage.

Completeness of excision was recorded both macroscopically from the operation note and microscopically from the pathology report for all patients who had their primary disease removed (n=832). Those not classified as having macroscopic disease were then classified based on their pathology data. Overall 79% of patients with non-metastatic colon cancer who had their primary disease removed had complete excision of their disease (95% CI: 79 to 82). Excision status was unknown for 12% of cases. Patients living in independent urban areas had the lowest percentage with complete excision (73%) compared to rural (80%) and urban (78%) (Table 4.10-15), but the differences were not statistically significant.

Table 4.10-13 Removal of primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Primary removed	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	582	91.1	141	92.2	109	93.2	832	91.5	0.8
No	56	8.8	12	7.8	8	6.8	76	8.4	
Unknown	1	0.2	0	0	0	0	1	0.1	
Total	639	100.0	153	100.0	117	100.0	909	100.0	

Table 4.10-14 Surgical procedure for removal of primary by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Surgery procedures	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Low/Ultra-low AR	270	45.2	59	40.1	57	50.9	386	45.0
APR	157	26.3	42	28.6	27	24.1	226	26.4
High AR	90	15.1	20	13.6	14	12.5	124	14.5
Transanal excision	31	5.2	5	3.4	2	1.8	38	4.4
Hartmanns	19	3.2	4	2.7	5	4.5	28	3.3
Other	13	2.2	7	4.8	0	0	20	2.3
Proctocolectomy	7	1.2	5	3.4	4	3.6	16	1.9
Right hemicolectomy	4	0.7	2	1.4	1	0.9	7	0.8
Left hemicolectomy	3	0.5	3	2.0	0	0	6	0.7
Sigmoid colectomy	4	0.7	0	0	2	1.8	6	0.7
Total	598	100.0	147	100.0	112	100.0	857	100.0

Other includes: Unknown removal of primary, local excision, total colectomy, subtotal colectomy, pelvic exenteration, rectal stump resection, transverse colectomy

Table 4.10-15 Completeness of excision by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Residual disease	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	24	4.1	5	3.5	7	6.4	36	4.3	0.8*
R1 (Microscopic disease)	20	3.4	4	2.8	3	2.8	27	3.2	
R0 (Complete Excision)	465	79.9	103	73.0	85	78.0	653	78.5	
RX (Undeterminable)	11	1.9	4	2.8	1	0.9	16	1.9	
R1 (Microscopic disease)-R2 unknown	2	0.3	1	0.7	0	0	3	0.4	
R0 (Complete Excision)-R2 unknown	16	2.7	7	5.0	2	1.8	25	3.0	
RX (Undeterminable)- R2 unknown	4	0.7	0	0	0	0	4	0.5	
Unknown - R2=No	33	5.7	13	9.2	8	7.3	54	6.5	
Unknown	7	1.2	4	2.8	3	2.8	14	1.7	
Total	582	100.0	141	100.0	109	100.0	832	100.0	

*p-value compares R0, R1 and R2. RX(Undeterminable) and unknowns are excluded.

For analyses of data from the pathology report we have excluded the 38 patients whose only operation for the removal of the primary was an anorectal procedure, leaving 794 patients included in these tables.

Information was collected from the pathology report on distance of the tumour from the circumferential resection margin of the excision. However the measure was not believed to be sufficiently reliable. Here we report the proportion for whom the distance from tumour to circumferential resection margin was recorded (Table 4.10-16).

Overall, 63% (95% CI:60 to 66) of patients had a measure for the distance of tumour from the circumferential resection margin recorded. It was recorded the least in the independent urban group (54%) compared with the urban group (66%) and the rural group (60%) (p=0.03).

Quality of mesorectal excision, as recorded on the pathology report for the main removal of the primary, is presented in Table 4.10-17. Overall, the mesorectal quality was classified as complete in 23% (95% CI:20 to 26) of the patients who had their primary removed. The proportion with complete mesorectal quality was lower in the independent urban group (17%) than the urban group (24%) and the rural group (25%) however there were a very large number of cases where the mesorectal quality was not known (overall: 65%).

Table 4.10-16 Whehter or not distance of tumour to circumferential resection margin was recorded in in the pathology report by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Distance of tumour to circumferential resection margin recorded	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	363	65.9	74	54.4	64	59.8	501	63.1	0.03
No	188	34.1	62	45.6	43	40.2	293	36.9	
Total	551	100.0	136	100.0	107	100.0	794	100.0	

Table 4.10-17 Quality of the mesorectal excision by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Mesorectal quality	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Complete	134	24.3	23	16.9	27	25.2	184	23.2	0.1
Incomplete	16	2.9	6	4.4	4	3.7	26	3.3	
Nearly complete	54	9.8	9	6.6	3	2.8	66	8.3	
Unknown	347	63.0	98	72.1	73	68.2	518	65.2	
Total	551	100.0	136	100.0	107	100.0	794	100.0	

For examination of the post-operative period during the hospital admission for the main surgery for removal of the primary, patients whose only operation for the removal of the primary was an anorectal procedure are excluded.

Overall the median length of stay during the admission for the main surgery for removal of the primary tumour was 10 days (IQ range 8-15) (Table 4.10-18). The only difference was that the median length of stay in the urban group was 11 days compared to 10 days in both the independent urban and rural groups. Overall, 8% (95% CI:6 to 10) of patients were returned to theatre post-operatively during the admission for the main operation to remove their primary disease. The group who had the highest proportion with a return to theatre was the independent urban group (10%) compared with the urban group (8%) and the rural group (8%). However the differences were not significantly different (p=0.7).

Table 4.10-18 Length of stay post-operation to remove primary by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Length of stay	Rurality of residence at time of diagnosis			
	Urban	Independent urban	Rural	All
Median	11.0	10.0	10.0	10.0
Lower quartile	8.0	8.0	8.0	8.0
Upper quartile	15.0	15.0	15.0	15.0
Number unknown	76	10	18	104

Table 4.10-19 Evidence of return to theatre post-operation to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Return to theatre	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	42	7.6	14	10.3	8	7.5	64	8.1	0.7
No	456	82.8	118	86.8	95	88.8	669	84.3	
Unknown	53	9.6	4	2.9	4	3.7	61	7.7	
Total	551	100.0	136	100.0	107	100.0	794	100.0	

Table 4.10-20 shows the proportion of patients within each group that had an anastomosis formed as part of their operation for removal of primary, for assessment of anastomotic leak rates (Table 4.10-21). Again patients whose only "operation" for the removal of the primary was an anorectal procedure were not included. There were some differences in the proportions of anastomoses formed by rurality.

Overall, 4% of the non-metastatic colon cancer patients who had an anastomosis formed as part of their operation for removal of primary had evidence of an anastomotic leak (95% CI:2 to 5) (Table 4.10-21). The group with the highest proportion with an anastomotic leak was the rural group (6%), as compared with the independent urban group (5%) and the urban group (3%). The differences were not significantly different (p=0.4), but the numbers of patients are small.

In the same patient group, the overall 30 day mortality for the patients with non-metastatic rectal cancer was 2% (95% CI:1 to 4) (Table 4.10-22). Thirty day mortality was highest in the independent urban group (5%) compared with the urban group (2%) and the rural group

(2%) but the differences were not statistically significant (p=0.07). The overall 90 day post-operative mortality was 3% (95% CI: 2 to 4) (Table 4.10-23). 90 day mortality was highest in the independent urban group (5%) compared with the urban group (3%) and the rural group (2%), but the numbers are still small, and the differences are not statistically significant.

Table 4.10-20 Formation of an anastomosis during operation for removal of primary by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

	Rurality of residence at time of diagnosis							
Anastomoses formed	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Yes	477	86.6	109	80.1	87	81.3	673	84.8
No	66	12.0	26	19.1	19	17.8	111	14.0
Unknown	8	1.5	1	0.7	1	0.9	10	1.3
Total	551	100.0	136	100.0	107	100.0	794	100.0

Table 4.10-21 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

	Rurality of residence at time of diagnosis								
Anastomotic leak	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	15	3.1	5	4.6	5	5.7	25	3.7	0.4
No	462	96.9	104	95.4	82	94.3	648	96.3	
Total	477	100.0	109	100.0	87	100.0	673	100.0	

Table 4.10-22 Mortality within 30 days post-operation to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

	Rurality of residence at time of diagnosis								
Mortality within 30days post-surgery	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	10	1.8	7	5.1	2	1.9	19	2.4	0.07
No	538	97.6	129	94.9	105	98.1	772	97.2	
Unknown	3	0.5	0	0	0	0	3	0.4	
Total	551	100.0	136	100.0	107	100.0	794	100.0	

Table 4.10-23 Mortality within 90 days post-operation to remove primary disease by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Mortality within 90days post-surgery	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	15	2.7	7	5.1	2	1.9	24	3.0	0.3
No	533	96.7	129	94.9	105	98.1	767	96.6	
Unknown	3	0.5	0	0	0	0	3	0.4	
Total	551	100.0	136	100.0	107	100.0	794	100.0	

Patients were classified as having been reviewed at a colorectal multidisciplinary meeting (CRC MDM) if their MDM was within 26 weeks prior to their first treatment or within 12 weeks after their first treatment. Patients who did not receive any treatment (other than palliative care) were classified as having been reviewed at a CRC MDM if their MDM was within 26 weeks prior to or 12 weeks post the date of decision not to treat. Overall 42% of patients had no evidence of review at a CRC MDM (95% CI:38 to 45) (Table 4.10-24). The proportion of patients not reviewed at MDM was similar across all groups (urban 42%; independent urban 41%; rural 40%). CRC MDM review was not known for a large proportion of patients (11% overall).

Table 4.10-24 Evidence of review at a colorectal multidisciplinary meeting by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

MDM review	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	37	5.8	8	5.2	4	3.4	49	5.4	0.5
8-0 weeks before first treatment	192	30.0	47	30.7	34	29.1	273	30.0	
Within 4 weeks after first treatment	22	3.4	3	2.0	3	2.6	28	3.1	
Within 4-8 weeks after first treatment	11	1.7	0	0	1	0.9	12	1.3	
Within 8-12 weeks after first treatment	7	1.1	4	2.6	5	4.3	16	1.8	
No	292	45.7	78	51.0	62	53.0	432	47.5	
Unknown	78	12.2	13	8.5	8	6.8	99	10.9	
Total	639	100.0	153	100.0	117	100.0	909	100.0	

*p-value calculated between MDM with time frame 26 weeks prior to 12 weeks post first treatment

Evidence of a myocardial infarction (MI) and pulmonary embolism (PE) occurring post-operatively during the admission period for the main surgery for removal of primary disease was collected. Patients whose only operation for the removal of the primary was an anorectal procedure were not included.

Overall 2% of cases who had their primary removed had a post-op MI (Table 4.10-25). Independent urban had the highest proportion of MI (4%) compared with the overall MI proportion (2%). Overall 1% of cases who had their primary removed had a post-op PE (Table 4.10-26). Numbers are very small in these groups so we have not presented formal statistical comparisons.

Table 4.10-25 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with myocardial infarction)

Myocardial infarction occurring during the post op admission period	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Yes	5	0.9	6	4.4	1	0.9	12	1.5
No	491	89.1	125	91.9	102	95.3	718	90.4
Unknown	55	10.0	5	3.7	4	3.7	64	8.1
Total	551	100.0	136	100.0	107	100.0	794	100.0

Table 4.10-26 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Yes	2	0.4	1	0.7	1	0.9	4	0.5
No	494	89.7	130	95.6	102	95.3	726	91.4
Unknown	55	10.0	5	3.7	4	3.7	64	8.1
Total	551	100.0	136	100.0	107	100.0	794	100.0

4.10.2.3 Distance from residence to facility of diagnosis for rectal cancer

Of the 924 patients with non-metastatic rectal cancer, 20 had unknown distance from residence to health facility they were diagnosed at, leaving 904 patient for the analyses in this section.

The proportion of patients who had their primary removed was slightly lower for patients living 5-10km from the diagnostic facility (88% vs. over 92% for the other groups), but the differences were not statistically significant (p=0.2) (Table 4.10-27).

Operations for removal of the primary are shown in Table 4.10-28. Patients living 0-5 km from the diagnostic facility were less likely to have had a low/ultra-low resection (37% compared with 48-52% for those groups living further away).

There was some variation in the proportion with complete excision of the primary tumour (75% in those living closest to the diagnostic facility vs. 79% - 84% for those further away, but the differences were not statistically significant (p=0.3). There was little variation in the recording of distance of tumour from the circumferential margin (p=0.7). There was more variation in the quality of the mesorectal excision (21% of those living 0-5 km from the diagnostic facility vs. 23-29% for those living further way, but these differences were also not statistically significant (p=0.8). The median and lower quartile for the length of stay in hospital for surgery for removal of the primary were similar across all distance groups, but there was more variation in the upper quartile, highest in those living closest to the health facility of diagnosis and those living further away. This may reflect comorbidity as well as surgical or medical complications of treatment. There was a higher proportion of patients who had to return to theatre during the admission for those living over 50km away (4% vs. under 6-9% for the remaining groups) but the difference was not statistically significant. The group living over 50km away also had a higher proportion with an anastomotic leak, 30 day mortality and 90 day mortality, but none of the differences were statistically significant.

The proportion of patients who did not have MDM review was lowest in the group living 5-10km from the diagnostic facility (38% compared with 50% for those living 0-5km away and 43% - 55 for those living further away) (p=0.009).

Table 4.10-27 Removal of primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Primary removed	Distance from residence to facility of diagnosis												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	298	91.7	151	87.8	135	94.4	155	91.7	88	92.6	827	91.5	0.3
No	26	8.0	21	12.2	8	5.6	14	8.3	7	7.4	76	8.4	
Unknown	1	0.3	0	0	0	0	0	0	0	0	1	0.1	
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	904	100.0	

Table 4.10-28 Surgical procedure for removal of primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Surgery operation -all surgery	Distance from residence to facility of diagnosis (km)											
	0-<5		20-<50		5-<10		10-<20		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Low/Ultra-low AR	114	37.0	76	47.8	79	51.6	68	48.6	46	50.0	383	45.0
APR	91	29.5	38	23.9	38	24.8	38	27.1	19	20.7	224	26.3
High AR	52	16.9	22	13.8	21	13.7	18	12.9	11	12.0	124	14.6
Transanal excision	20	6.5	5	3.1	3	2.0	6	4.3	4	4.3	38	4.5
Hartmanns	10	3.2	6	3.8	6	3.9	2	1.4	4	4.3	28	3.3
Other	8	2.6	2	1.3	3	2.0	3	2.1	4	4.3	20	2.3
Proctocolectomy	7	2.3	4	2.5	0	0	2	1.4	3	3.3	16	1.9
Right hemicolectomy	2	0.6	2	1.3	1	0.7	1	0.7	1	1.1	7	0.8
Left hemicolectomy	3	1.0	1	0.6	1	0.7	1	0.7	0	0	6	0.7
Sigmoid colectomy	1	0.3	3	1.9	1	0.7	1	0.7	0	0	6	0.7
Total	308	100.0	159	100.0	153	100.0	140	100.0	92	100.0	852	100.0

Other includes: Unknown removal of primary, local excision, total colectomy, subtotal colectomy, pelvic exenteration, rectal stump resection, transverse colectomy

Table 4.10-29 Completeness of excision by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Residual disease	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	13	4.4	6	4.0	9	6.7	7	4.5	1	1.1	36	4.4	0.6
R1 (Microscopic disease)	11	3.7	2	1.3	4	3.0	7	4.5	3	3.4	27	3.3	
R0 (Complete Excision)	223	74.8	127	84.1	108	80.0	123	79.4	69	78.4	650	78.6	
RX (Undeterminable)	7	2.3	6	4.0	0	0	1	0.6	2	2.3	16	1.9	
R1 (Microscopic disease)-R2 unknown	1	0.3	1	0.7	0	0	0	0	1	1.1	3	0.4	
R0 (Complete Excision)-R2 unknown	9	3.0	4	2.6	3	2.2	3	1.9	5	5.7	24	2.9	
RX (Undeterminable)- R2 unknown	1	0.3	0	0	1	0.7	2	1.3	0	0	4	0.5	
Unknown - R2=No	24	8.1	5	3.3	8	5.9	10	6.5	6	6.8	53	6.4	
Unknown	9	3.0	0	0	2	1.5	2	1.3	1	1.1	14	1.7	
Total	298	100.0	151	100.0	135	100.0	155	100.0	88	100.0	827	100.0	

*p-value compares R0, R1 and R2. RX(Undeterminable) and unknowns are excluded.

Table 4.10-30 Distance of tumour to circumferential resection margin reported by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Distance of tumour to circumferential resection margin	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	179	64.4	92	62.2	76	58.9	95	63.3	57	67.9	499	63.2	0.7
No	99	35.6	56	37.8	53	41.1	55	36.7	27	32.1	290	36.8	
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0	

Table 4.10-31 Mesorectal quality by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Mesorectal quality	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Complete	57	20.5	43	29.1	33	25.6	34	22.7	16	19.0	183	23.2	0.8
Incomplete	8	2.9	7	4.7	3	2.3	5	3.3	3	3.6	26	3.3	
Nearly complete	28	10.1	16	10.8	10	7.8	9	6.0	3	3.6	66	8.4	
Unknown	185	66.5	82	55.4	83	64.3	102	68.0	62	73.8	514	65.1	
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0	

Table 4.10-32 Length of stay post-operation to remove primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Length of stay	Distance from residence to facility of diagnosis (km)					
	0-<5	5-<10	10-<20	20-<50	50>/=	All
Median	11.0	10.0	11.0	10.0	10.0	10.0
Lower quartile	8.0	8.0	8.0	8.0	8.0	8.0
Upper quartile	16.0	13.0	14.0	15.0	15.0	15.0
Number unknown	33	19	22	18	9	101

Table 4.10-33 Evidence of return to theatre post-operation to remove primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Return to theatre	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	21	7.6	9	6.1	11	8.5	11	7.3	12	14.3	64	8.1	0.3
No	240	86.3	127	85.8	103	79.8	127	84.7	70	83.3	667	84.5	
Unknown	17	6.1	12	8.1	15	11.6	12	8.0	2	2.4	58	7.4	
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0	

Table 4.10-34 Formation of an anastomosis during operation for removal of primary by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Anastomoses formed	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	235	84.5	124	83.8	108	83.7	132	88.0	70	83.3	669	84.8
No	40	14.4	22	14.9	20	15.5	16	10.7	13	15.5	111	14.1
Unknown	3	1.1	2	1.4	1	0.8	2	1.3	1	1.2	9	1.1
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0

Table 4.10-35 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Anastomotic leak	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	5	2.1	3	2.4	4	3.7	8	6.1	5	7.1	25	3.7	0.2
No	230	97.9	121	97.6	104	96.3	124	93.9	65	92.9	644	96.3	
Total	235	100.0	124	100.0	108	100.0	132	100.0	70	100.0	669	100.0	

Table 4.10-36 Mortality within 30 days post-operation to remove primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Mortality within 30days post-surgery	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	4	1.4	2	1.4	3	2.3	5	3.3	5	6.0	19	2.4	0.1
No	273	98.2	145	98.0	125	96.9	145	96.7	79	94.0	767	97.2	
Unknown	1	0.4	1	0.7	1	0.8	0	0	0	0	3	0.4	
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0	

Table 4.10-37 Mortality within 90 days post-operation to remove primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Mortality within 90days post-surgery	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	5	1.8	4	2.7	5	3.9	5	3.3	5	6.0	24	3.0	0.4
No	272	97.8	143	96.6	123	95.3	145	96.7	79	94.0	762	96.6	
Unknown	1	0.4	1	0.7	1	0.8	0	0	0	0	3	0.4	
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0	

Table 4.10-38 Evidence of review at a colorectal multidisciplinary meeting by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

MDM review	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	15	4.6	10	5.8	7	4.9	11	6.5	6	6.3	49	5.4	0.009
8-0 weeks before first treatment	94	28.9	63	36.6	28	19.6	65	38.5	23	24.2	273	30.2	
Within 4 weeks after first treatment	11	3.4	5	2.9	6	4.2	4	2.4	2	2.1	28	3.1	
Within 4-8 weeks after first treatment	5	1.5	4	2.3	2	1.4	0	0	1	1.1	12	1.3	
Within 8-12 weeks after first treatment	3	0.9	3	1.7	3	2.1	2	1.2	5	5.3	16	1.8	
No	162	49.8	66	38.4	76	53.1	73	43.2	52	54.7	429	47.5	
Unknown	35	10.8	21	12.2	21	14.7	14	8.3	6	6.3	97	10.7	
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	904	100.0	

Table 4.10-39 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with myocardial infarction)

Myocardial infarction occurring during the post op admission period	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	2	0.7	1	0.7	1	0.8	5	3.3	3	3.6	12	1.5
No	259	93.2	133	89.9	113	87.6	132	88.0	79	94.0	716	90.7
Unknown	17	6.1	14	9.5	15	11.6	13	8.7	2	2.4	61	7.7
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0

Table 4.10-40 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	2	0.7	0	0	0	0	2	1.3	0	0	4	0.5
No	259	93.2	134	90.5	114	88.4	135	90.0	82	97.6	724	91.8
Unknown	17	6.1	14	9.5	15	11.6	13	8.7	2	2.4	61	7.7
Total	278	100.0	148	100.0	129	100.0	150	100.0	84	100.0	789	100.0

4.10.2.4 Area deprivation of residence at diagnosis for rectal cancer

Of the 924 patients with non-metastatic rectal cancer, the NZ Deprivation index score for their meshblock of residence at the time of diagnosis was unknown for 21, leaving 903 patients for the analyses in this section.

The proportion of patients who had their primary removed was highest for patients living in areas with the least deprivation (1-2) (96% compared with 89-93% in areas with higher deprivation (p=0.025).

Operations for removal of the primary are shown in Table 4.10-41. Patients living in areas of greatest deprivation (9-10) were less likely to have had a low/ultra-low resection (40% compared with 44-48% for the remaining groups).

There was little variation in the proportion with complete excision of the primary tumour (p=0.4), or in the recording of distance of tumour from the circumferential margin (p=0.8), or the quality of the mesorectal excision (p=0.3).

The median and lower quartile for the length of stay in hospital for surgery for removal of the primary were similar across all deprivation groups, but there was more variation in the upper quartile; the groups in the areas of highest deprivation had the highest upper quartile, indicating there may be a greater proportion of patients with long stays. This may reflect comorbidity as well as surgical or medical complications of treatment. There was no evidence that a greater proportion of those from areas of higher deprivation needed a return to theatre during the admission for surgery for removal of their primary tumour (p=0.2). There was also no evidence of a difference in the proportions with an anastomotic leak (p=0.2), or in 30 day or 90 day mortality. There was also no evidence in a difference in the proportion having a review at an MDM (p=0.5).

Table 4.10-42 Removal of primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Primary removed	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	183	96.3	176	89.3	186	93.0	155	88.6	127	90.1	827	91.6	0.03
No	6	3.2	21	10.7	14	7.0	20	11.4	14	9.9	75	8.3	
Unknown	1	0.5	0	0	0	0	0	0	0	0	1	0.1	
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	903	100.0	

Table 4.10-43 Surgical procedure for removal of primary by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Surgery operation -all surgery	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Low/Ultra-low AR	92	48.4	84	46.7	86	44.8	69	43.9	53	39.8	384	45.1
APR	47	24.7	47	26.1	50	26.0	45	28.7	35	26.3	224	26.3
High AR	32	16.8	29	16.1	20	10.4	22	14.0	21	15.8	124	14.6
Transanal excision	2	1.1	9	5.0	11	5.7	6	3.8	10	7.5	38	4.5
Hartmanns	6	3.2	5	2.8	9	4.7	3	1.9	5	3.8	28	3.3
Proctocolectomy	1	0.5	1	0.6	6	3.1	4	2.5	3	2.3	15	1.8
Right hemicolectomy	2	1.1	1	0.6	0	0	2	1.3	2	1.5	7	0.8
Left hemicolectomy	2	1.1	0	0	2	1.0	1	0.6	1	0.8	6	0.7
Sigmoid colectomy	3	1.6	0	0	2	1.0	0	0	1	0.8	6	0.7
Other	3	1.6	4	2.2	6	3.1	5	3.2	2	1.5	20	2.3
Total	190	100.0	180	100.0	192	100.0	157	100.0	133	100.0	852	100.0

Table 4.10-44 Completeness of excision by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Residual disease	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	7	3.8	12	6.8	5	2.7	6	3.9	5	3.9	35	4.2	0.4
R1 (Microscopic disease)	3	1.6	6	3.4	7	3.8	7	4.5	3	2.4	26	3.1	
R0 (Complete Excision)	146	79.8	133	75.6	142	76.3	121	78.1	108	85.0	650	78.6	
RX (Undeterminable)	5	2.7	4	2.3	5	2.7	2	1.3	0	0	16	1.9	
R1 (Microscopic disease)-R2 unknown	0	0	0	0	2	1.1	1	0.6	0	0	3	0.4	
R0 (Complete Excision)-R2 unknown	4	2.2	5	2.8	6	3.2	6	3.9	4	3.1	25	3.0	
RX (Undeterminable)- R2 unknown	0	0	1	0.6	2	1.1	0	0	1	0.8	4	0.5	
Unknown - R2=No	15	8.2	13	7.4	12	6.5	8	5.2	6	4.7	54	6.5	
Unknown	3	1.6	2	1.1	5	2.7	4	2.6	0	0	14	1.7	
Total	183	100.0	176	100.0	186	100.0	155	100.0	127	100.0	827	100.0	

*p-value compares R0, R1 and R2. RX (Undeterminable) and unknowns are excluded

Table 4.10-45 Distance of tumour to circumferential resection margin reported by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Distance of tumour to circumferential resection margin	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	110	60.8	106	63.5	106	60.6	97	65.1	78	66.7	497	63.0	0.8
No	71	39.2	61	36.5	69	39.4	52	34.9	39	33.3	292	37.0	
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0	

Table 4.10-46 Mesorectal qualityby area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer (p=0.3)

Mesorectal quality	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Complete	39	21.5	40	24.0	49	28.0	31	20.8	24	20.5	183	23.2	0.3
Incomplete	7	3.9	6	3.6	2	1.1	8	5.4	3	2.6	26	3.3	
Nearly complete	12	6.6	19	11.4	10	5.7	15	10.1	10	8.5	66	8.4	
Unknown	123	68.0	102	61.1	114	65.1	95	63.8	80	68.4	514	65.1	
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0	

Table 4.10-47 Length of stay post-operation to remove primary by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Length of stay	NZ Deprivation Index of residence at time of diagnosis					
	1-2	3-4	5-6	7-8	9-10	All
Median	9.0	10.0	11.0	11.0	12.0	10.0
Lower quartile	7.0	8.0	8.0	8.0	9.0	8.0
Upper quartile	13.0	14.0	14.5	15.0	17.0	15.0
Number unknown	33	28	23	11	6	101

Table 4.10-48 Evidence of return to theatre post-operation to remove primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Return to theatre	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	7	3.9	15	9.0	18	10.3	11	7.4	13	11.1	64	8.1	0.2
No	153	84.5	139	83.2	144	82.3	133	89.3	97	82.9	666	84.4	
Unknown	21	11.6	13	7.8	13	7.4	5	3.4	7	6.0	59	7.5	
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0	

Table 4.10-49 Formation of an anastomosis during operation for removal of primary by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Anastomoses formed	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	159	87.8	138	82.6	148	84.6	120	80.5	104	88.9	669	84.8
No	20	11.0	28	16.8	24	13.7	25	16.8	13	11.1	110	13.9
Unknown	2	1.1	1	0.6	3	1.7	4	2.7	0	0	10	1.3
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0

Table 4.10-50 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by area deprivation score for residence at the time of diagnosis

Anastomotic leak	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	3	1.9	9	6.5	5	3.4	6	5.0	2	1.9	25	3.7	0.2
No	156	98.1	129	93.5	143	96.6	114	95.0	102	98.1	644	96.3	
Total	159	100.0	138	100.0	148	100.0	120	100.0	104	100.0	669	100.0	

Table 4.10-51 Mortality within 30 days post-operation to remove primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Mortality within 30days post-surgery	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	3	1.7	6	3.6	2	1.1	6	4.0	2	1.7	19	2.4	0.3
No	178	98.3	161	96.4	171	97.7	142	95.3	115	98.3	767	97.2	
Unknown	0	0	0	0	2	1.1	1	0.7	0	0	3	0.4	
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0	

Table 4.10-52 Mortality within 90 days post-operation to remove primary disease by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

Mortality within 90days post-surgery	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	4	2.2	6	3.6	5	2.9	6	4.0	3	2.6	24	3.0	0.9
No	177	97.8	161	96.4	168	96.0	142	95.3	114	97.4	762	96.6	
Unknown	0	0	0	0	2	1.1	1	0.7	0	0	3	0.4	
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0	

Table 4.10-53 Evidence of review at a colorectal multidisciplinary meeting by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer

MDM review	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	10	5.3	11	5.6	11	5.5	7	4.0	10	7.1	49	5.4	0.5
8-0 weeks before first treatment	49	25.8	61	31.0	62	31.0	55	31.4	43	30.5	270	29.9	
Within 4 weeks after first treatment	10	5.3	5	2.5	6	3.0	2	1.1	4	2.8	27	3.0	
Within 4-8 weeks after first treatment	0	0	5	2.5	1	0.5	3	1.7	3	2.1	12	1.3	
Within 8-12 weeks after first treatment	2	1.1	5	2.5	3	1.5	5	2.9	1	0.7	16	1.8	
No	96	50.5	83	42.1	94	47.0	94	53.7	65	46.1	432	47.8	
Unknown	23	12.1	27	13.7	23	11.5	9	5.1	15	10.6	97	10.7	
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	903	100.0	

Table 4.10-54 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with myocardial infarction)

Myocardial infarction occurring during the post op admission period	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	0	0	3	1.8	1	0.6	3	2.0	5	4.3	12	1.5
No	160	88.4	149	89.2	161	92.0	142	95.3	103	88.0	715	90.6
Unknown	21	11.6	15	9.0	13	7.4	4	2.7	9	7.7	62	7.9
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0

Table 4.10-55 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by area deprivation score for residence at the time of diagnosis for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	1	0.6	0	0	0	0	2	1.3	1	0.9	4	0.5
No	159	87.8	152	91.0	162	92.6	143	96.0	107	91.5	723	91.6
Unknown	21	11.6	15	9.0	13	7.4	4	2.7	9	7.7	62	7.9
Total	181	100.0	167	100.0	175	100.0	149	100.0	117	100.0	789	100.0

4.10.2.5 Ethnicity for rectal cancer

Of the 1063 patients with non-metastatic rectal cancer, 4 had unknown ethnicity, leaving 1059 patients for the analyses in this section.

The proportion of Pacific patients who had their primary removed was 81%, compared with 96% for Māori and 91% for nMnP (p=0.05) (Table 4.10-56). The type of operation varied, with a lower proportion of Pacific patients having low/ultra-low APR (40%) compared with 47% of Māori and 47% of nMnP (Table 4.10-57). A greater proportion of Pacific patients had APR or high APR (compared with Māori or nMnP patients).

The proportion of Pacific patients with complete excision was lower (71%) compared with Māori (77%) and nMnP (80%) (p=0.01) (Table 4.10-58). The Pacific patients also had a lower proportion with distance to the circumferential margin of the resection reported (47%) compared with Māori (57%) and nMnP (63%) (Table 4.10-59), and a smaller proportion with mesorectal excision complete (19% vs. 24% for Māori and 23% for nMnP) although neither of these were statistically significantly different (p=0.1 and p=0.3 respectively) (Table 4.10-60).

For all three groups the median length of stay was around 11 days, with very similar distributions (Table 4.10-61). The proportion of Māori patients who returned to theatre was 11%, compared with 3% for Pacific and 9% for nMnP, but the differences were not statistically significant (p=0.4) (Table 4.10-62).There were no differences in the proportions of patients with an anastomotic leak, although the numbers are very small (p=0.5).

The proportion of Pacific patients for whom there was no evidence of review at MDM was 62%, compared with 33% for Māori and 47% for nMnP (0.02).

The 30 day and 90 day mortality and proportions with MI or PE during the post-operative period are also reported, but numbers are too small for reliable estimation of event rates in the separate ethnic groups.

Table 4.10-56 Removal of primary disease by prioritised ethnicity for patients with non-metastatic rectal cancer

Primary removed	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	87	95.6	34	81.0	846	91.4	967	91.3	0.05
No	4	4.4	7	16.7	79	8.5	90	8.5	
Unknown	0	0	1	2.4	1	0.1	2	0.2	
Total	91	100.0	42	100.0	926	100.0	1059	100.0	

Table 4.10-57 Surgical procedure for removal of primary by prioritised ethnicity for patients with non-metastatic rectal cancer

Surgery procedure	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Low/Ultra-low AR	41	46.6	14	40.0	405	46.6	460	46.3
APR	18	20.5	10	28.6	228	26.2	256	25.8
High AR	13	14.8	7	20.0	121	13.9	141	14.2
Transanal excision	8	9.1	2	5.7	36	4.1	46	4.6
Hartmanns	1	1.1	0	0	29	3.3	30	3.0
Proctocolectomy	4	4.5	0	0	14	1.6	18	1.8
Right hemicolectomy	0	0	0	0	7	0.8	7	0.7
Left hemicolectomy	0	0	0	0	7	0.8	7	0.7
Sigmoid colectomy	0	0	0	0	6	0.7	6	0.6
Other	3	3.4	2	5.7	17	2.0	22	2.2
Total	88	100.0	35	100.0	870	100.0	993	100.0

Table 4.10-58 Completeness of excision by prioritised ethnicity for patients with non-metastatic rectal cancer.

Residual disease	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
R2 (Macroscopic disease)	1	1.1	2	5.9	35	4.1	38	3.9	0.01*
R1 (Microscopic disease)	4	4.6	4	11.8	22	2.6	30	3.1	
R0 (Complete Excision)	67	77.0	24	70.6	673	79.6	764	79.0	
RX (Undeterminable)	4	4.6	0	0	15	1.8	19	2.0	
R1 (Microscopic disease)-R2 unknown	0	0	0	0	4	0.5	4	0.4	
R0 (Complete Excision)-R2 unknown	2	2.3	1	2.9	31	3.7	34	3.5	
RX (Undeterminable)- R2 unknown	1	1.1	0	0	4	0.5	5	0.5	
Unknown - R2=No	7	8.0	3	8.8	48	5.7	58	6.0	
Unknown	1	1.1	0	0	14	1.7	15	1.6	
Total	87	100.0	34	100.0	846	100.0	967	100.0	

*p-value compares R0, R1 and R2, RX(undeterminable) and unknowns are excluded

Table 4.10-59 Distance of tumour to circumferential resection margin reported by prioritised ethnicity for patients with non-metastatic rectal cancer

Distance of tumour to circumferential resection margin reported	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	45	57.0	15	46.9	513	63.3	573	62.2	0.1
No	34	43.0	17	53.1	297	36.7	348	37.8	
Total	79	100.0	32	100.0	810	100.0	921	100.0	

Table 4.10-60 Mesorectal quality by prioritised ethnicity for patients with non-metastatic rectal cancer

Mesorectal quality	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Complete	19	24.1	6	18.8	186	23.0	211	22.9	0.3
Incomplete	0	0	2	6.3	28	3.5	30	3.3	
Nearly complete	4	5.1	2	6.3	65	8.0	71	7.7	
Unknown	56	70.9	22	68.8	531	65.6	609	66.1	
Total	79	100.0	32	100.0	810	100.0	921	100.0	

Table 4.10-61 Length of stay post-operation to remove primary by prioritised ethnicity for patients with non-metastatic rectal cancer.

Length of stay	Prioritised ethnicity			
	Māori	Pacific	nMnP	All
Median	11.5	11.0	10.5	11.0
Lower quartile	8.0	8.0	8.0	8.0
Upper quartile	16.5	17.0	15.0	15.0
Number unknown	7	2	114	123

Table 4.10-62 Evidence of return to theatre post-operation to remove primary disease by prioritised ethnicity for patients with non-metastatic rectal cancer

Return to theatre	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	9	11.4	1	3.1	70	8.6	80	8.7	0.4
No	65	82.3	29	90.6	671	82.8	765	83.1	
Unknown	5	6.3	2	6.3	69	8.5	76	8.3	
Total	79	100.0	32	100.0	810	100.0	921	100.0	

Table 4.10-63 Formation of an anastomosis during operation for removal of primary by prioritised ethnicity for patients with non-metastatic rectal cancer

Anastomoses formed	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Yes	67	84.8	31	96.9	682	84.2	780	84.7
No	10	12.7	1	3.1	111	13.7	122	13.2
Unknown	2	2.5	0	0	17	2.1	19	2.1
Total	79	100.0	32	100.0	810	100.0	921	100.0

Table 4.10-64 Evidence of anastomotic leak in patients who had an anastomosis formed during their operation for removal of primary disease by prioritised ethnicity for patients with non-metastatic rectal cancer

Anastomotic leak	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	5	7.5	1	3.2	29	4.3	35	4.5	0.4
No	62	92.5	30	96.8	653	95.7	745	95.5	
Total	67	100.0	31	100.0	682	100.0	780	100.0	

Table 4.10-65 Mortality within 30 days post-operation to remove primary disease by prioritised ethnicity for patients with non-metastatic rectal cancer

Mortality within 30days post-surgery	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	2	2.5	0	0	18	2.2	20	2.2	0.9
No	77	97.5	32	100.0	789	97.4	898	97.5	
Unknown	0	0	0	0	3	0.4	3	0.3	
Total	79	100.0	32	100.0	810	100.0	921	100.0	

Table 4.10-66 Mortality within 90 days post-operation to remove primary disease by prioritised ethnicity for patients with non-metastatic rectal cancer

Mortality within 90days post-surgery	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	2	2.5	1	3.1	23	2.8	26	2.8	0.9
No	77	97.5	31	96.9	784	96.8	892	96.9	
Unknown	0	0	0	0	3	0.4	3	0.3	
Total	79	100.0	32	100.0	810	100.0	921	100.0	

Table 4.10-67 Evidence of review at a colorectal multidisciplinary meeting by prioritised ethnicity for patients with non-metastatic rectal cancer

MDM review	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	6	6.6	1	2.4	50	5.4	57	5.4	0.02
8-0 weeks before first treatment	28	30.8	10	23.8	270	29.2	308	29.1	
Within 4 weeks after first treatment	6	6.6	2	4.8	32	3.5	40	3.8	
Within 4-8 weeks after first treatment	2	2.2	0	0	13	1.4	15	1.4	
Within 8-12 weeks after first treatment	2	2.2	0	0	16	1.7	18	1.7	
No	30	33.0	26	61.9	438	47.3	494	46.6	
Unknown	17	18.7	3	7.1	107	11.6	127	12.0	
Total	91	100.0	42	100.0	926	100.0	1059	100.0	

Table 4.10-68 Evidence of myocardial infarction post-operation to remove primary disease prior to discharge by prioritised ethnicity for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with myocardial infarction)

Myocardial infarction occurring during the post op admission period	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Yes	1	1.3	1	3.1	13	1.6	15	1.6
No	72	91.1	29	90.6	725	89.5	826	89.7
Unknown	6	7.6	2	6.3	72	8.9	80	8.7
Total	79	100.0	32	100.0	810	100.0	921	100.0

Table 4.10-69 Evidence of pulmonary embolism post-operation to remove primary disease prior to discharge by prioritised ethnicity for patients with non-metastatic rectal cancer (p-value not calculated due to small numbers with pulmonary embolism)

Pulmonary embolism occurring during the post op admission period	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Yes	0	0	0	0	6	0.7	6	0.7
No	73	92.4	30	93.8	731	90.2	834	90.6
Unknown	6	7.6	2	6.3	73	9.0	81	8.8
Total	79	100.0	32	100.0	810	100.0	921	100.0

4.10.2.6 Key points: surgical treatment for non-metastatic rectal cancer

Demographic characteristics:

- There were significant differences in age distribution by ethnicity; Pacific had the greatest proportion of patients diagnosed at a young age, followed by Māori then nMnP.

Primary removal:

- There were similar proportions of patients who had their primary removed regardless of urban/rurality location.
- The proportions with restorative resection (ultra-low AR, high AR & sigmoid colectomy) were 61%, 53.7% and 65.2% for urban, independent urban & rural respectively.

Quality indicators:

- The rates of R0 resection were 80%, 73% and 78% for urban, independent urban & rural respectively.
- The rates of recording the tumour distance from the circumferential resection margin were 66%, 54% and 60% for urban, independent urban & rural respectively
- The rates of complete mesorectal excision were generally low and were 24%, 17% and 25% for urban, independent urban & rural respectively
- While the pattern suggests quality may be lower in independent urban areas, the differences were not statistically significant.

Discussion at MDM:

- The proportion of patients with non-metastatic rectal cancer discussed pre-operatively at an MDM was low
- Only 53% of rectal cancer patients had any MDM discussion of their case and only 35% of rectal cancer patients had an MDM discussion before the first treatment

4.10.2.7 Discussion: surgical treatment for non-metastatic rectal cancer

Important epidemiological differences in the age distribution of rectal cancer by ethnicity are revealed by this study. Pacific patients have a much higher incidence or rectal cancer at a young age with 19% of rectal cancer in Pacific people diagnosed before 40 years of age as compared to 2.2% of Māori and 1.3% of nMnP. The age distribution in nMnP is predominantly later in life with 50% of cancers diagnosed after the age of 70 while the corresponding percentage is 24% for Māori and Pacific patients alike. Some of the difference will be accounted for by the differences in the age distribution in the population by ethnicity; the next phase of our work will present age-adjusted incidence rates. There does not appear to be a difference in the gender distribution of rectal cancer by ethnicity with 60% of rectal cancer diagnosed in men regardless of ethnicity.

Effect of ethnicity on outcome of rectal cancer KPIs

The numbers of Pacific and Māori in these analyses are too small to make statistically valid conclusions in some instances, however Pacific patients have a lower rate of removal of the primary tumour at 81% as opposed to 91% for nMnP and 95.6% for Māori. The R0 (microscopic free surgical margin) rate is also lower for Pacific patients than nMnP and Māori. One plausible explanation for these two findings is that Pacific patients present with more advanced rectal cancer at diagnosis. Amongst those having a resection of the primary tumour there is no difference in the rate of restorative resection between ethnic groups at about 60% in all three groups.

Effect of deprivation on rectal cancer KPIs

Patients in Deprivation Index group 1-2 had had a higher proportion with removal of the primary at 96% compared to 90% in group 9-10. They also had a higher rate of restorative resection at 69% as compared to 59 % for groups 9-10.

30 and 90 day Mortality

The 30 and 90 day mortality following rectal cancer surgery in this series ,at 2.2% and 2.9% respectively, is good by international comparison with other large nationally collected datasets that incorporate both elective and emergency surgery rather than single unit or surgeon case series.

Rurality and distance

There was little difference in the KPIs between the urban and the rural population however the independent urban population had consistently worse outcome measures including restorative resection rates, R0 resection rate and rate of return to theatre. While the differences were not statistically significant this deserves further investigation.

When the effect of rurality was measured by the distance of the patient's residential address from the diagnostic facility a trend for poorer outcomes by distance was also observed for return to theatre rate.

Anastomotic leak rates

The anastomotic leak rate was lower than reported in international literature.[52, 75, 76] For our calculation of anastomotic leak, we included whether there was any evidence of anastomosis in the surgical note (any anastomosis) in the denominator. At the time of analysis we noted that this may have resulted in over-counting, including some non-colonic anastomoses. This highlights some of the difficulties with extracting information relating to factors subject to technical interpretation and therefore we advise caution in interpreting this result.

Highlights: non-metastatic rectal cancer

Surgical Treatment

92% of patients with non-metastatic rectal cancer underwent resection of their primary

Complete excision was reported for 79% of cases

Distance to CRM was unknown for 37% of cases

Mesorectal quality was unknown for 65% of patients

Median length of post-operative stay was 10 days

8% of patients had unplanned return to theatre

30 day post-operative mortality was 2%, and 90 day post-operative mortality was 3%

There was no evidence of MDM discussion for 48% of patients

4.10.3 Non-metastatic rectal cancer: neoadjuvant and adjuvant therapy

4.10.3.1 Key performance indicators (KPIs) for neoadjuvant and adjuvant therapy for non-metastatic rectal cancer

The key performance indicators used for describing the neoadjuvant and adjuvant treatment of rectal cancer in this section are:

- Proportion of patients with non-metastatic rectal cancer receiving any radiotherapy
- Whether radiotherapy was pre- or post-operative
- Proportion receiving short vs. long course pre-op radiotherapy
- Whether chemotherapy was delivered in combination with radiotherapy, what form this took, and whether it was completed
- Proportion of patients completing planned pre-op radiotherapy
- Whether adjuvant chemotherapy was administered, and what form this took

The optimal treatment strategy for rectal cancer has evolved dramatically over the last 30 years since Heald described the total mesorectal excision (TME) procedure in 1982. Local recurrence rates of 25-40% were reported,[77] however with TME, the local recurrence (LR) rate at 5 years following anterior resection was 4%. This very low rate of local recurrence was not seen in other institutions, where chemoradiotherapy (either pre- or post-operatively) remained a component of care. Based on the low rates of local recurrence from TME surgery, the technique was widely adopted. However results achieved by Heald et al were not always able to be immediately replicated and local recurrence remains a clinically important problem.

Three prospective studies evaluated the benefit of pre-operative chemoradiotherapy compared with post-operative chemoradiotherapy. RTOG 9401 closed prematurely after accruing 53 patients, and NSABP R03 also closed early after accruing 267 of a planned 900 patients. The German CAO/ARO/AIO-94 randomised study accrued 823 patients, and demonstrated a lower rate of local recurrence with a pre-operative strategy compared to a post-operative approach with no difference in overall survival (LR 7.1 v 10.1%; p=0.048).

The EORTC 22921 study had a 2x2 factorial design and showed pre-operative radiotherapy was superior to post-operative radiotherapy, and pre-operative chemoradiotherapy was associated with lower local relapse than radiotherapy alone.[78]

However the role of pre-operative (chemo)radiotherapy in the era of TME continues to be questioned, particularly given that irradiated patients have a higher rate of wound complications, greater problems with erections, and more dissatisfaction with bowel function.[79]

Three randomised studies showed an improvement in local control with short-course pre-operative radiotherapy compared to surgery alone, or surgery with selective post-operative radiotherapy if the surgical margin was involved.[80-82] However these studies were criticised because not all surgeries were achieved in the mesorectal plane, and stage one patients were included.

Two studies have compared conventional long-course chemoradiotherapy with short-course radiotherapy, although inclusion criteria differed, and MRI staging was not mandated in the Polish study. Rates of local recurrence were not significantly different between arms in either trial,[83, 84] although were numerically lower with long course in both.

Because of higher toxicity with radiotherapy and acceptably low rates of local recurrence with TME surgery alone, many centres continue to risk-stratify patients, with T1-2N0 patients receiving surgery alone, and others selected for radiotherapy on the basis of either nodal positivity or threatened circumferential margin.

The NZGG guideline notes "the addition of RT to surgery for patients with rectal cancer is beneficial; whenever possible, preoperative treatment is preferred since it is more effective and less toxic than postoperative treatment". The guideline does not make an explicit recommendation on whether all patients or selected patients should receive (chemo)radiotherapy, and does not recommend a fractionation schedule. The NZ practice has not, to our knowledge, been previously described.

The role of adjuvant chemotherapy following surgery also remains controversial. A recent meta-analysis of four trials found no evidence of benefit of adjuvant chemotherapy for patients with tumours 0-10cm from the anal verge whom had received treatment with chemoradiotherapy.[85] This meta-analysis did not include the ADORE study, which was published at a similar time to the meta-analysis. The ADORE study compared 5FU/LV compared to FOLFOX in patients with pathological stage II or III rectal cancer following chemoradiotherapy and showed a significant improvement in DFS for FOLFOX over 5FU/LV.[86]

The role of adjuvant chemotherapy following TME surgery alone or following short-course pre-operative radiotherapy has not been clarified. The NCCN guideline continues to recommend adjuvant chemotherapy even if a pCR has been obtained, and the ESMO guideline states that adjuvant chemotherapy can be given in stage III and high risk stage II disease.

4.10.3.2 Neo-adjuvant therapy for rectal cancer

4.10.3.2.1 Rurality of residence at diagnosis for rectal cancer

Of the 924 patients with non-metastatic rectal cancer diagnosed in 2007 and 2008, 566 had radiotherapy as part of their initial treatment. Of these 481 had curative neoadjuvant therapy, 60 had curative adjuvant therapy, 2 had both adjuvant and neoadjuvant, 17 had neoadjuvant therapy but it was not classed as curative (mostly palliative) and for 6 one or more of the necessary dates was unknown so their therapy could not be classified as either neoadjuvant or adjuvant.

For 15 patients their address could not be linked to a rurality classification; these patients have been excluded from the tables looking at rurality.

Overall 52% of the patients with non-metastatic rectal cancer patients received radiotherapy either pre-operatively or post-operatively (95% CI: 49 to 55) (Table 4.10-70). A greater proportion of patients in the rural areas had radiotherapy (64%) compared with urban areas

(49%) and independent urban areas (54%) (p=0.01). However the differences are likely to be at least partially attributable to differences in the populations of patients in urban vs. rural areas, such as age, gender, level of comorbidity and disease stage. Further analyses in the second phase will explore whether or not there would be any difference in the likelihood of receiving radiotherapy for an individual patient with the same demographic and clinical characteristics in urban compared with rural areas.

The overall proportion of rectal cancer patients seeing both a medical and a radiation oncologist before surgery for resection of their primary tumour was 33% (95% CI: 30 to 37) (Table 4.10-71). The proportion of patients who saw both specialists was higher in rural areas (43%) than urban areas (31%) or independent urban areas (35%) (p=0.04) (Table 4.10-71). 55% of patients did not see either a radiation or a medical oncologist before surgery (51% to 58%).

Of the 473 patients who received any radiotherapy, 89% (95% CI: 86 to 91) received pre-operative radiotherapy (Table 4.10-72). The proportions were similar in the urban and rural regions (p=0.4). Long course radiotherapy was the most common form of radiotherapy; the proportion of those receiving any neoadjuvant therapy who received long course therapy was 82% (95% CI:78 to 86) (Table 4.10-73). There was no difference by urban/rural regions (p=0.8).

Among the 331 patients who received long course radiotherapy, for 74% it was delivered in combination with chemotherapy, and for 11% the chemotherapy was sequential. There was little difference by rurality (p=0.7) (Table 4.10-74). Of the 420 patients who received any preoperative radiotherapy over 94% completed the course as planned in all 3 regions.

Table 4.10-70 Radiotherapy (overall) by rurality of residence at the time of diagnosis for patients with non-metastatic rectal cancer

	Rurality of residence at time of diagnosis								
Any radiotherapy	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Any RT	315	49.3	83	54.2	75	64.1	473	52.0	0.01
No RT	322	50.4	69	45.1	42	35.9	433	47.6	
Unknown	2	0.3	1	0.7	0	0	3	0.3	
Total	639	100.0	153	100.0	117	100.0	909	100.0	

Table 4.10-71 Assessment by radiation and medical oncology before surgery by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Specialist seen pre-surgery	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Medical and radiation oncology	199	31.1	54	35.3	50	42.7	303	33.3	0.04
Medical oncology only	4	0.6	3	2.0	0	0	7	0.8	
Radiation oncology only	68	10.6	17	11.1	15	12.8	100	11.0	
Neither	368	57.6	79	51.6	52	44.4	499	54.9	
Total	639	100.0	153	100.0	117	100.0	909	100.0	

Table 4.10-72 Pre-operative radiotherapy by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	276	87.6	77	92.8	67	89.3	420	88.8	0.4
No	39	12.4	6	7.2	8	10.7	53	11.2	
Total	315	100.0	83	100.0	75	100.0	473	100.0	

Table 4.10-73 Form of pre-operative radiotherapy by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Curative neo-adjuvant short course	49	15.6	11	13.3	12	16.0	72	15.2	0.8*
Curative neo-adjuvant long course	219	69.5	60	72.3	52	69.3	331	70.0	
Curative neo-adjuvant course unknown	1	0.3	2	2.4	0	0	3	0.6	
Neo-adjuvant, other	7	2.2	4	4.8	3	4.0	14	3.0	
No neoadjuvant radiotherapy	39	12.4	6	7.2	8	10.7	53	11.2	
Total	315	100.0	83	100.0	75	100.0	473	100.0	

*p-value compares long and short course neo-adjuvant radiotherapy

Table 4.10-74 Chemo-radiation by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Type of long course radiotherapy	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Radiotherapy with chemotherapy	162	74.0	45	75.0	38	73.1	245	74.0	0.7
Radiotherapy with sequential chemotherapy	20	9.1	8	13.3	7	13.5	35	10.6	
Radiation only	37	16.9	7	11.7	7	13.5	51	15.4	
Total	219	100.0	60	100.0	52	100.0	331	100.0	

Table 4.10-75 Completion of pre-operative radiotherapyby rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Completed planned pre-op radiotherapy	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	271	98.2	76	98.7	63	94.0	410	97.6	0.1
No	5	1.8	1	1.3	4	6.0	10	2.4	
Total	276	100.0	77	100.0	67	100.0	420	100.0	

Pre-operative chemotherapy was received by 292 of the 909 patients with non-metastatic rectal cancer (32%, 95% CI: 29 to 35). The proportions for the three regions were 29% for urban areas, 37% for independent urban and 41% for rural areas (p=0.01). In their first chemotherapy regimen 72% of the patients who received chemotherapy were on 5FU while 28% received capecitabine, an oral analogue of 5FU. The proportions of 5FU to capecitabine did not vary by rurality (0.2) (Table 4.10-76).

Table 4.10-77 shows the reasons for stopping the first chemotherapy regimen. Of the 15% who stopped early the most common reason was toxicity.

Table 4.10-76 Pre-operative chemotherapy by rurality of residence at time of diagnosis

Chemotherapy received	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
5FU	129	69.0	42	73.7	39	81.3	210	71.9	0.2
Capecitabine	58	31.0	15	26.3	9	18.8	82	28.1	
Total	187	100.0	57	100.0	48	100.0	292	100.0	

Table 4.10-77 Reason given for stopping first regimen of chemotherapy by rurality of residence at time of diagnosis

Reason for stopping chemotherapy	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Toxicity	20	10.7	10	17.5	6	12.5	36	12.3
Unrelated adverse event, co-morbidity	2	1.1	1	1.8	1	2.1	4	1.4
Patient request	2	1.1	0	0	0	0	2	0.7
Other	1	0.5	1	1.8	0	0	2	0.7
Planned duration complete	162	86.6	45	78.9	41	85.4	248	84.9
Total	187	100.0	57	100.0	48	100.0	292	100.0

4.10.3.2.2 Distance of residence from health facility of diagnosis for rectal cancer

There were 20 patients for whom the distance from their residence to the health facility where their disease was diagnosed could not be calculated, leaving 904 patients with non-metastatic rectal cancer for the distance analyses.

The proportion of those who received pre-operative radiotherapy increased with distance from the diagnostic facility, although the difference was not statistically significant (p=0.2) (Table 4.10-78). Any differences may be related to underlying differences in patient characteristics. This will be explored in the second phase of analysis.

There was no overall difference in the proportions of patients who were assessed by radiation and/or medical oncology before surgery by distance of residence from health facility of diagnosis (p=0.1), and no differences in the proportion who received pre-operative radiotherapy (p=0.2) (Table 4.10-79, Table 4.10-80). The proportion who received long course neo-adjuvant therapy was highest among patients living the areas that were 5-10km from the health facility of diagnosis (81% compared with 61-72% either closer or further away) but the

differences were not statistically significant (p=0.1) (Table 4.10-81). There was little difference in the proportions who received chemotherapy either at the same time as the radiotherapy (chemoradiation) or sequentially by distance from the health facility of diagnosis (p=0.95) or in the proportions who completed the planned course of radiotherapy (p=0.6) (Table 4.10-82, Table 4.10-83).

Of the patients who received pre-operative chemotherapy, the proportion receiving 5FU rather than capecitabine was higher in the areas 5-10km from the health facility where they were diagnosed (80%) than in other areas (64-73%) but the differences were not statistically significant (p=0.5) (Table 4.10-84). The numbers stopping chemotherapy early were too small for making comparisons by distance (Table 4.10-85).

Table 4.10-78 Radiotherapy (overall) by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Any radiotherapy	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Any RT	152	46.8	93	54.1	78	54.5	94	55.6	54	56.8	471	52.1	0.2
No RT	171	52.6	79	45.9	65	45.5	74	43.8	41	43.2	430	47.6	
Unknown	2	0.6	0	0	0	0	1	0.6	0	0	3	0.3	
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	904	100.0	

Table 4.10-79 Assessment by radiation and medical oncology before surgeryby distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Specialist seen pre-surgery	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Medical and radiation oncology	102	31.4	64	37.2	47	32.9	66	39.1	24	25.3	303	33.5	0.1
Medical oncology only	4	1.2	1	0.6	0	0	1	0.6	1	1.1	7	0.8	
Radiation oncology only	35	10.8	13	7.6	16	11.2	16	9.5	19	20.0	99	11.0	
Neither	184	56.6	94	54.7	80	55.9	86	50.9	51	53.7	495	54.8	
Total	325	100.0	172	100.0	143	100.0	169	100.0	95	100.0	904	100.0	

Table 4.10-80 Pre-operative radiotherapy by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	134	88.2	88	94.6	65	83.3	83	88.3	49	90.7	419	89.0	0.2
No	18	11.8	5	5.4	13	16.7	11	11.7	5	9.3	52	11.0	
Total	152	100.0	93	100.0	78	100.0	94	100.0	54	100.0	471	100.0	

Table 4.10-81 Form of pre-operative radiotherapy by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value*
Curative neo-adjuvant short course	22	14.5	9	9.7	14	17.9	13	13.8	13	24.1	71	15.1	0.1
Curative neo-adjuvant long course	109	71.7	75	80.6	51	65.4	63	67.0	33	61.1	331	70.3	
Curative neo-adjuvant course unknown	0	0	1	1.1	0	0	1	1.1	1	1.9	3	0.6	
Neo-adjuvant, other	3	2.0	3	3.2	0	0	6	6.4	2	3.7	14	3.0	
No neoadjuvant radiotherapy	18	11.8	5	5.4	13	16.7	11	11.7	5	9.3	52	11.0	
Total	152	100.0	93	100.0	78	100.0	94	100.0	54	100.0	471	100.0	

*p-value compares short and long course neo-adjuvant radiotherapy

Table 4.10-82 Chemo-radiation by ruralityby distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Type of long course radiotherapy	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Radiotherapy with chemotherapy	81	74.3	54	72.0	39	76.5	47	74.6	24	72.7	245	74.0	0.95
Radiotherapy with sequential chemotherapy	10	9.2	7	9.3	7	13.7	7	11.1	4	12.1	35	10.6	
Radiotherapy only	18	16.5	14	18.7	5	9.8	9	14.3	5	15.2	51	15.4	
Total	109	100.0	75	100.0	51	100.0	63	100.0	33	100.0	331	100.0	

Table 4.10-83 Completion of pre-operative radiotherapyby distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Completed planned pre-op radiotherapy	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	132	98.5	85	96.6	63	96.9	80	96.4	49	100.0	409	97.6	0.6
No	2	1.5	3	3.4	2	3.1	3	3.6	0	0	10	2.4	
Total	134	100.0	88	100.0	65	100.0	83	100.0	49	100.0	419	100.0	

Table 4.10-84 Pre-operative chemotherapyby distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Chemotherapy regimen	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU	67	69.8	49	80.3	32	68.1	44	73.3	18	64.3	210	71.9	0.5
Capecitabine	29	30.2	12	19.7	15	31.9	16	26.7	10	35.7	82	28.1	
Total	96	100.0	61	100.0	47	100.0	60	100.0	28	100.0	292	100.0	

Table 4.10-85 Reason given for stopping first regimen of chemotherapyby distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Toxicity	10	10.4	9	14.8	3	6.4	12	20.0	2	7.1	36	12.3
Unrelated adverse event, co-morbidity	1	1.0	0	0	1	2.1	2	3.3	0	0	4	1.4
Patient request	1	1.0	1	1.6	0	0	0	0	0	0	2	0.7
Other	0	0	1	1.6	0	0	1	1.7	0	0	2	0.7
Planned duration complete	84	87.5	50	82.0	43	91.5	45	75.0	26	92.9	248	84.9
Total	96	100.0	61	100.0	47	100.0	60	100.0	28	100.0	292	100.0

4.10.3.2.3 Area deprivation of residence at diagnosis for rectal cancer

The proportion of patients who had received any radiotherapy did not vary by area deprivation of residence at diagnosis (p=0.7) (Table 4.10-86), and neither did the specialist(s) seen before surgery (p=0.4) (Table 4.10-87). The proportion receiving pre-operative radiotherapy was similarly consistent across levels of deprivation (p=0.1). Although not statistically significant, there is a suggestion that those in deprivation areas 9-10 may be more likely to have short course radiotherapy than long course, compared with other deprivation quintiles (58% vs 70-77% for the other groups) (p=0.4) (Table 4.10-88, Table 4.10-89). The proportions receiving chemoradiation were higher in the lower deprivation areas (1-2) (84%) than in areas of higher deprivation (9-10) (74%), but the differences were not statistically significant (0.1) (Table 4.10-90). A very high proportion of patients completed radiotherapy as planned in all areas (Table 4.10-91). The proportions of those receiving pre-operative chemotherapy who were on 5FU vs capecitabine were lower in the areas of highest deprivation (9-10) (59% vs 69-81% elsewhere), but the difference was not statistically significant (p=0.2) (Table 4.10-92).

Table 4.10-86 Radiotherapy (overall) by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Any radiotherapy	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Any RT	99	52.1	108	54.8	103	51.5	93	53.1	67	47.5	470	52.0	0.7
No RT	91	47.9	88	44.7	95	47.5	82	46.9	74	52.5	430	47.6	
Unknown	0	0	1	0.5	2	1.0	0	0	0	0	3	0.3	
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	903	100.0	

Table 4.10-87 Assessment by radiation and medical oncology before surgery by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Specialist seen pre-surgery	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Medical and radiation oncology	68	35.8	70	35.5	69	34.5	58	33.1	37	26.2	302	33.4	0.4
Medical oncology only	2	1.1	1	0.5	3	1.5	1	0.6	0	0	7	0.8	
Radiation oncology only	17	8.9	22	11.2	22	11.0	19	10.9	18	12.8	98	10.9	
Neither	103	54.2	104	52.8	106	53.0	97	55.4	86	61.0	496	54.9	
Total	190	100.0	197	100.0	200	100.0	175	100.0	141	100.0	903	100.0	

Table 4.10-88 Pre-operative radiotherapy by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	86	86.9	97	89.8	95	92.2	82	88.2	57	85.1	417	88.7	0.1
No	13	13.1	11	10.2	8	7.8	11	11.8	10	14.9	53	11.3	
Total	99	100.0	108	100.0	103	100.0	93	100.0	67	100.0	470	100.0	

Table 4.10-89 Form of pre-operative radiotherapy by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Curative neo-adjuvant short course	16	16.2	13	12.0	15	14.6	13	14.0	14	20.9	71	15.1	0.4*
Curative neo-adjuvant long course	69	69.7	77	71.3	79	76.7	65	69.9	39	58.2	329	70.0	
Curative neo-adjuvant course unknown	0	0	0	0	0	0	1	1.1	2	3.0	3	0.6	
Neo-adjuvant, other	1	1.0	7	6.5	1	1.0	3	3.2	2	3.0	14	3.0	
No neoadjuvant radiotherapy	13	13.1	11	10.2	8	7.8	11	11.8	10	14.9	53	11.3	
Total	99	100.0	108	100.0	103	100.0	93	100.0	67	100.0	470	100.0	

*p-value compares short and long course neo-adjuvant radiotherapy

Table 4.10-90 Chemo-radiation by rurality by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Type of long course radiotherapy	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Radiotherapy with chemotherapy	58	84.1	59	76.6	55	69.6	43	66.2	29	74.4	244	74.2	0.1
Radiotherapy with sequential chemotherapy	8	11.6	5	6.5	12	15.2	7	10.8	3	7.7	35	10.6	
Radiotherapy only	3	4.3	13	16.9	12	15.2	15	23.1	7	17.9	50	15.2	
Total	69	100.0	77	100.0	79	100.0	65	100.0	39	100.0	329	100.0	

Table 4.10-91 Completion of pre-operative radiotherapy by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Completed planned pre-op radiotherapy	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Yes	86	100.0	96	99.0	91	95.8	77	93.9	57	100.0	407	97.6
No	0	0	1	1.0	4	4.2	5	6.1	0	0	10	2.4
Total	86	100.0	97	100.0	95	100.0	82	100.0	57	100.0	417	100.0

Table 4.10-92 Pre-operative chemotherapy by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Chemotherapy regimen	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU	47	69.1	54	80.6	51	72.9	37	71.2	20	58.8	209	71.8	0.2
Capecitabine	21	30.9	13	19.4	19	27.1	15	28.8	14	41.2	82	28.2	
Total	68	100.0	67	100.0	70	100.0	52	100.0	34	100.0	291	100.0	

Table 4.10-93 Reason given for stopping first regimen of chemotherapy by area deprivation of residence at time of diagnosis for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Toxicity	7	10.3	7	10.4	8	11.4	7	13.5	7	20.6	36	12.4
Unrelated adverse event, co-morbidity	1	1.5	1	1.5	1	1.4	1	1.9	0	0	4	1.4
Patient request	1	1.5	0	0	0	0	0	0	1	2.9	2	0.7
Other	0	0	0	0	1	1.4	1	1.9	0	0	2	0.7
Planned duration complete	59	86.8	59	88.1	60	85.7	43	82.7	26	76.5	247	84.9
Total	68	100.0	67	100.0	70	100.0	52	100.0	34	100.0	291	100.0

4.10.3.2.4 Ethnicity for rectal cancer

Of the 1066 patients presenting with non-metastatic rectal cancer, 1063 were diagnosed in 2006-2009. For 4 of these patients ethnicity was unknown.

The proportion of Māori who received any radiotherapy was 63%, for Pacific patients it was 43% and for nMnP patients it was 53% (p=0.09) (Table 4.10-94). The differences were not statistically significant, although the numbers are small even in the extended cohort once we restrict the PIPER group to those with non-metastatic rectal cancer. Furthermore, the apparent difference might be explained by differences in age, comorbidity, disease stage and different practices in different treating centres.

A greater proportion of Māori patients were assessed by both medical and radiation oncology before surgery (52% compared with 33% of Pacific patients and 33% of nMnP patients, p=0.001) (Table 4.10-95). The proportions who had preoperative radiotherapy varied by ethnicity (81% for Māori, 94% for Pacific and 89% for nMnP), but the differences were not statistically significant (p=0.1) (Table 4.10-96).

For Māori patients the proportion of those who received pre-operative radiotherapy who were given long course radiotherapy was 91%, for Pacific patients it was 94% and nMnP 81% (Table 4.10-97). The proportions who received chemoradiation were similar in the three ethnic groups (73-75%) (Table 4.10-98). However in the subgroup of patients who received radiotherapy the numbers were very small so none of the estimates for Māori patients and Pacific patients are very precise.

The proportions of patients who received preoperative chemotherapy were 45% for Māori patients, 31% for Pacific patients and 32% for nMnP (Table 4.10-100). Of those on chemotherapy, the proportions on capecitabine were 20% for Māori, 46% for Pacific and 28% for nMnP (but p=0.2).

Table 4.10-94 Radiotherapy (overall) by prioritised ethnicity for patients with non-metastatic rectal cancer

Any radiotherapy	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Any RT	57	62.6	18	42.9	488	52.7	563	53.2	0.09
No RT	34	37.4	23	54.8	435	47.0	492	46.5	
Unknown	0	0	1	2.4	3	0.3	4	0.4	
Total	91	100.0	42	100.0	926	100.0	1059	100.0	

Table 4.10-95 Assessment by radiation and medical oncology before surgeryby prioritised ethnicity for patients with non-metastatic rectal cancer

Specialist seen pre-surgery	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Medical and radiation oncology	47	51.6	14	33.3	302	32.6	363	34.3	0.001
Medical oncology only	0	0	0	0	7	0.8	7	0.7	
Radiation oncology only	4	4.4	0	0	109	11.8	113	10.7	
Neither	40	44.0	28	66.7	508	54.9	576	54.4	
Total	91	100.0	42	100.0	926	100.0	1059	100.0	

Table 4.10-96 Pre-operative radiotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	46	80.7	17	94.4	434	88.9	497	88.3	0.1
No	11	19.3	1	5.6	54	11.1	66	11.7	
Total	57	100.0	18	100.0	488	100.0	563	100.0	

Table 4.10-97 Form of pre-operative radiotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Pre-operative radiotherapy	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Curative neo-adjuvant short course	4	7.0	1	5.6	81	16.6	86	15.3	0.1*
Curative neo-adjuvant long course	39	68.4	15	83.3	337	69.1	391	69.4	
Curative neo-adjuvant course unknown	1	1.8	0	0	2	0.4	3	0.5	
Neo-adjuvant, other	2	3.5	1	5.6	14	2.9	17	3.0	
No neoadjuvant radiotherapy	11	19.3	1	5.6	54	11.1	66	11.7	
Total	57	100.0	18	100.0	488	100.0	563	100.0	

*p-value compares long and short course neo-adjuvant radiotherapy

Table 4.10-98 Chemo-radiation by ruralityby prioritised ethnicity for patients with non-metastatic rectal cancer

Type of long course radiotherapy	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Radiotherapy with chemotherapy	29	74.4	11	73.3	253	75.1	293	74.9	0.1
Radiotherapy with sequential chemotherapy	8	20.5	1	6.7	33	9.8	42	10.7	
Radiotherapy only	2	5.1	3	20.0	51	15.1	56	14.3	
Total	39	100.0	15	100.0	337	100.0	391	100.0	

Table 4.10-99 Completion of pre-operative radiotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Completed planned pre-op radiotherapy	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	45	97.8	17	100.0	423	97.5	485	97.6	0.9999
No	1	2.2	0	0	11	2.5	12	2.4	
Total	46	100.0	17	100.0	434	100.0	497	100.0	

Table 4.10-100 Pre-operative chemotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Chemotherapy regimen	Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
5FU	33	80.5	7	53.8	213	72.4	253	72.7	0.2
Capecitabine	8	19.5	6	46.2	81	27.6	95	27.3	
Total	41	100.0	13	100.0	294	100.0	348	100.0	

Table 4.10-101 Reason given for stopping first regimen of chemotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Toxicity	3	7.3	1	7.7	39	13.3	43	12.4
Unrelated adverse event, co-morbidity	2	4.9	0	0	5	1.7	7	2.0
Patient request	0	0	0	0	2	0.7	2	0.6
Other	0	0	0	0	2	0.7	2	0.6
Planned duration complete	36	87.8	12	92.3	246	83.7	294	84.5
Total	41	100.0	13	100.0	294	100.0	348	100.0

4.10.3.3 Adjuvant therapy for rectal cancer

4.10.3.3.1 Rurality of residence at diagnosis for rectal cancer

Of the 473 patients with non-metastatic rectal cancer who received radiotherapy (either pre- or post-operative), 49 (10%) had curative adjuvant (post-operative) radiotherapy (95% CI:78 to 14) (Table 4.10-102). This equates to 5% of the total group of patients with non-metastatic rectal cancer. There was no evidence of a difference in proportions in the 3 urban/rural groups (p=0.5). Of the 49 who received radiotherapy it was given concurrently with chemotherapy in 39% of the patients (95% CI: 25 to 54) (Table 4.10-103). Comparisons by rurality are limited by the small numbers.

Table 4.10-102 Curative post-operative radiotherapy by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer who received radiotherapy

Post-operative radiotherapy	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Curative adjuvant	34	10.8	6	7.2	9	12.0	49	10.4	0.5
Adjuvant, other	2	0.6	0	0	0	0	2	0.4	
No post-op radiotherapy	279	88.6	77	92.8	66	88.0	422	89.2	
Total	315	100.0	83	100.0	75	100.0	473	100.0	

Table 4.10-103 Post-operative chemoradiation by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Post-operative radiotherapy	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Radiotherapy with chemotherapy	13	38.2	2	33.3	4	44.4	19	38.8
Radiotherapy only	21	61.8	4	66.7	5	55.6	30	61.2
Total	34	100.0	6	100.0	9	100.0	49	100.0

Of the 909 patients with non-metastatic rectal cancer, 832 had their primary tumour resected. The proportion who were seen by a medical oncologist at some point during their initial treatment was 60% (95% CI: 57 to 63) (Table 4.10-104). There were some differences in the proportions between urban and rural areas (rural 66%, urban 59% and independent urban 61%), but they were not statistically significant. We note that the comparison of the crude proportions across groups is not very informative regarding equity of service delivery because of the variations in distribution of age, gender, comorbidity and disease characteristics across the groups.

Of the 832 patients who had their primary tumour resected, 55% (95% CI: 52 to 58) were offered chemotherapy as part of their initial treatment, either pre- or post- surgery (92% of those seen by a medical oncologist) (Table 4.10-105).

There were 291 patients who received adjuvant chemotherapy, 73% had either 5FU or capecitabine alone and 28% had 5FU/capecitabine plus oxaliplatin (Table 4.10-106). The percentage on oral chemotherapy (capecitabine) was 40% (95% CI:35 to 46). The differences by rurality were not statistically significant (p=0.4), but the numbers outside urban areas were fairly small (Table 4.10-107).

Where adjuvant chemotherapy was not completed as planned, we looked at the reason given for stopping. Of the 291 patients who received adjuvant therapy, 99 stopped early (34%) (Table 4.10-108). The proportion of these who stopped early due to toxicity was 63%. For the patients on post-operative adjuvant therapy who also had pre-operative chemotherapy, the proportion who completed at least 18 weeks of post-operative adjuvant therapy was 47% (95% CI: 40to 55) (Table 4.10-109). For patients on post-operative adjuvant therapy who did not have pre-operative chemotherapy the proportion who completed at least 24 weeks of post-operative adjuvant therapy was 41% (95% CI: 32% to 50%).

Table 4.10-104 Assessment by medical oncologyeither pre- or post-surgery by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Medical oncology FSA attended	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	341	58.6	86	61.0	72	66.1	499	60.0	0.3
No	240	41.2	54	38.3	37	33.9	331	39.8	
Unknown	1	0.2	1	0.7	0	0	2	0.2	
Total	582	100.0	141	100.0	109	100.0	832	100.0	

Table 4.10-105 Chemotherapy offered either pre- or post-surgery by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Chemotherapy offered	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	310	53.3	80	56.7	67	61.5	457	54.9	0.2
No	271	46.6	60	42.6	41	37.6	372	44.7	
Unknown	1	0.2	1	0.7	1	0.9	3	0.4	
Total	582	100.0	141	100.0	109	100.0	832	100.0	

Table 4.10-106 Post-operative chemotherapy regimen by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Post-op Chemotherapy regimen	Rurality of residence at time of diagnosis							
	Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Capecitabine alone	70	34.7	19	42.2	19	43.2	108	37.1
5FU alone	74	36.6	15	33.3	14	31.8	103	35.4
Capecitabine + oxaliplatin	45	22.3	10	22.2	10	22.7	65	22.3
5FU + oxaliplatin	13	6.4	1	2.2	1	2.3	15	5.2
Total	202	100.0	45	100.0	44	100.0	291	100.0

Table 4.10-107 Post-operative use of oral chemotherapy by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Chemotherapy regimen	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
5FU	115	56.9	29	64.4	29	65.9	173	59.5	0.4
Capecitabine	87	43.1	16	35.6	15	34.1	118	40.5	
Total	202	100.0	45	100.0	44	100.0	291	100.0	

Table 4.10-108 Reason for stopping chemotherapyearly by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	Rurality of residence at time of diagnosis: Urban		Independent urban		Rural			
	N	%	N	%	N	%	Total	%
Toxicity	42	65.6	9	50.0	11	64.7	62	62.6
Unrelated adverse event, co-morbidity	3	4.7	1	5.6	3	17.6	7	7.1
Progression of cancer or recurrence	0	0	3	16.7	1	5.9	4	4.0
Patient request	8	12.5	1	5.6	2	11.8	11	11.1
Change of chemotherapy	6	9.4	0	0	0	0	6	6.1
Other	1	1.6	2	11.1	0	0	3	3.0
Unknown	4	6.3	2	11.1	0	0	6	6.1
Total	64	100.0	18	100.0	17	100.0	99	100.0

Table 4.10-109 Duration of chemotherapy by rurality of residence at time of diagnosis for patients with non-metastatic rectal cancer

Duration of chemotherapy (chem)		Rurality of residence at time of diagnosis							
		Urban		Independent urban		Rural			
		N	%	N	%	N	%	Total	%
Pre-op chem	Adjuvant:								
	At least 24 weeks	9	7.8	4	14.3	2	6.7	15	8.6
	18-23 weeks	52	44.8	7	25.0	8	26.7	67	38.5
	Less than 18 weeks	54	46.6	16	57.1	19	63.3	89	51.1
	Unknown	1	0.9	1	3.6	1	3.3	3	1.7
	Total	116	100.0	28	100.0	30	100.0	174	100.0
No pre-op chem	Adjuvant:								
	At least 24 weeks	37	43.0	7	41.2	4	28.6	48	41.0
	18-23 weeks	28	32.6	6	35.3	4	28.6	38	32.5
	Less than 18 weeks	15	17.4	3	17.6	5	35.7	23	19.7
	Unknown	6	7.0	1	5.9	1	7.1	8	6.8
	Total	86	100.0	17	100.0	14	100.0	117	100
	Total	202	100.0	45	100.0	44	100.0	291	100.0

4.10.3.3.2 Distance of residence from health facility of diagnosis for rectal cancer

There were 471 patients with non-metastatic rectal cancer who received radiotherapy (either pre- or post-operatively) for whom distance from health facility of diagnosis was known. There were some differences in the estimates of proportions receiving curative post-operative radiotherapy (of those who received any radiotherapy) (from 4-15%), but these differences were not statistically significant (p=0.2), indicating these differences could be due to random variation (Table 4.10-110).

The proportion of patients who attended an assessment by a medical oncologist did not vary greatly by distance from the health facility of diagnosis (proportions between 55% and 64%, p=0.5) (Table 4.10-112). There was more data here (n=827) as this was measured on all patients with non-metastatic rectal cancer. The proportions of patients offered chemotherapy were similar in the distance groups (p=0.95) (Table 4.10-113). The proportion of patients on capecitabine, the oral analogue of 5FU, did not appear to increase with increasing distance from the health facility of diagnosis (p=0.1) (Table 4.10-114). We did not observe any patterns in duration of chemotherapy by distance from the health facility of diagnosis (Table 4.10-116).

Table 4.10-110 Curative post-operative radiotherapy by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer who received radiotherapy

Post-operative radiotherapy	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Curative adjuvant	17	11.2	4	4.3	12	15.4	10	10.6	5	9.3	48	10.2	0.2
Adjuvant, other	1	0.7	0	0	1	1.3	0	0	0	0	2	0.4	
No	134	88.2	89	95.7	65	83.3	84	89.4	49	90.7	421	89.4	
Total	152	100.0	93	100.0	78	100.0	94	100.0	54	100.0	471	100.0	

Table 4.10-111 Post-operative chemoradiation by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Post-operative radiotherapy	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Radiotherapy with chemotherapy	4	23.5	4	100.0	4	33.3	4	40.0	2	40.0	18	37.5
Radiotherapy only	13	76.5	0	0	8	66.7	6	60.0	3	60.0	30	62.5
Total	17	100.0	4	100.0	12	100.0	10	100.0	5	100.0	48	100.0

Table 4.10-112 Assessment by medical oncology either pre- or post-surgery by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Medical oncology FSA attended	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	173	58.1	96	63.6	79	58.5	98	63.2	48	54.5	494	59.7	0.5
No	124	41.6	54	35.8	56	41.5	57	36.8	40	45.5	331	40.0	
Unknown	1	0.3	1	0.7	0	0	0	0	0	0	2	0.2	
Total	298	100.0	151	100.0	135	100.0	155	100.0	88	100.0	827	100.0	

Table 4.10-113 Chemotherapy offered either pre- or post-surgery by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Chemotherapy offered	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	156	52.3	88	58.3	76	56.3	88	56.8	45	51.1	453	54.8	0.95
No	141	47.3	62	41.1	59	43.7	66	42.6	43	48.9	371	44.9	
Unknown	1	0.3	1	0.7	0	0	1	0.6	0	0	3	0.4	
Total	298	100.0	151	100.0	135	100.0	155	100.0	88	100.0	827	100.0	

Table 4.10-114 Post operative chemotherapy regimen by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Chemotherapy regimen	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Capecitabine alone	38	40.0	16	25.8	20	38.5	26	49.1	6	23.1	106	36.8
5FU alone	37	38.9	27	43.5	15	28.8	14	26.4	9	34.6	102	35.4
Capecitabine + oxaliplatin	17	17.9	13	21.0	14	26.9	11	20.8	10	38.5	65	22.6
5FU + oxaliplatin	3	3.2	6	9.7	3	5.8	2	3.8	1	3.8	15	5.2
Total	95	100.0	62	100.0	52	100.0	53	100.0	26	100.0	288	100.0

Table 4.10-115 Post-operative use of oral chemotherapy by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Chemotherapy regimen	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU	55	57.9	29	46.8	34	65.4	37	69.8	16	61.5	171	59.4	0.1
Capecitabine	40	42.1	33	53.2	18	34.6	16	30.2	10	38.5	117	40.6	
Total	95	100.0	62	100.0	52	100.0	53	100.0	26	100.0	288	100.0	

Table 4.10-116 Reason for stopping chemotherap yearly by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	Distance from residence to facility of diagnosis (km)											
	0-<5		5-<10		10-<20		20-<50		50>/=			
	N	%	N	%	N	%	N	%	N	%	Total	%
Toxicity	17	60.7	12	63.2	13	61.9	13	68.4	7	63.6	62	63.3
Unrelated adverse event, co-morbidity	1	3.6	1	5.3	3	14.3	1	5.3	1	9.1	7	7.1
Progression of cancer or recurrence	1	3.6	0	0	1	4.8	0	0	2	18.2	4	4.1
Patient request	3	10.7	3	15.8	2	9.5	2	10.5	1	9.1	11	11.2
Change of chemotherapy	2	7.1	1	5.3	2	9.5	1	5.3	0	0	6	6.1
Other	1	3.6	0	0	0	0	1	5.3	0	0	2	2.0
Unknown	3	10.7	2	10.5	0	0	1	5.3	0	0	6	6.1
Total	28	100.0	19	100.0	21	100.0	19	100.0	11	100.0	98	100.0

Table 4.10-117 Duration of chemotherapy by distance of residence at time of diagnosis to the health facility where the diagnosis was made for patients with non-metastatic rectal cancer

Duration of chemotherapy (chem)		Distance from residence to facility of diagnosis (km)											
		0-<5		5-<10		10-<20		20-<50		50>/=			
		N	%	N	%	N	%	N	%	N	%	Total	%
Pre-op chemotherapy	Post op chem												
	At least 24 weeks	4	7.3	4	9.8	3	10.3	2	5.7	2	14.3	15	5.2
	18-23 weeks	27	49.1	16	39.0	9	31.0	11	31.4	4	28.6	67	23.3
	Less than 18 weeks	22	40.0	21	51.2	17	58.6	21	60.0	8	57.1	89	30.9
	Unknown	2	3.6	0	0	0	0	1	2.9	0	0	3	1.0
	Total	55	100.0	41	100.0	29	100.0	35	100.0	14	100.0	174	60.4
No pre-op chemotherapy	Post op chem												
	At least 24 weeks	17	42.5	11	52.4	7	30.4	6	33.3	6	50.0	47	16.3
	18-23 weeks	13	32.5	7	33.3	7	30.4	7	38.9	2	16.7	36	12.5
	Less than 18 weeks	8	20.0	2	9.5	6	26.1	4	22.2	3	25.0	23	8.0
	Unknown	2	5.0	1	4.8	3	13.0	1	5.6	1	8.3	8	2.8
	Total	40	100.0	21	100.0	23	100.0	18	100.0	12	100.0	114	39.6
	Total	95	100.0	62	100.0	52	100.0	53	100.0	26	100.0	288	100.0

4.10.3.3.3 Area deprivation of residence at diagnosis for rectal cancer

There were 470 patient with non-metastatic rectal cancer who received radiotherapy (either pre- or post-operatively) for whom the NZ Deprivation Index for their residence at diagnosis was known. There was some variation in the estimates of the proportion receiving curative post-operative radiotherapy (of those who received any radiotherapy), from 9-15%, but there was no clear pattern and the differences were not statistically significant (p=0.7) (Table 4.10-118).

The proportions of patients offered chemotherapy were lower in areas of higher deprivation, ranging from 61% to 45%, but the overall difference was not statistically significant (p=0.7) (Table 4.10-121). Further planned analyses will model linear trends, and evaluate confounding by demographic and other clinical characteristics of the patients, as numbers allow.

The proportion of patients on capecitabine, the oral analogue of 5FU, did appear to be slightly higher in areas with greater deprivation, but the overall differences were not statistically significant (p=0.4) (Table 4.10-123).

Table 4.10-118 Curative post-operative radiotherapy by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer who received radiotherapy

Post-operative radiotherapy	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Curative adjuvant	11	11.1	10	9.3	8	7.8	10	10.8	10	14.9	49	10.4	0.7
Adjuvant, other	1	1.0	0	0	0	0	1	1.1	0	0	2	0.4	
No	87	87.9	98	90.7	95	92.2	82	88.2	57	85.1	419	89.1	
Total	99	100.0	108	100.0	103	100.0	93	100.0	67	100.0	470	100.0	

Table 4.10-119 Post-operative chemoradiation by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Post-operative radiotherapy	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Radiotherapy with chemotherapy	6	50.0	1	100.0	20	40.8	27	43.5
Radiotherapy only	6	50.0	0	0	29	59.2	35	56.5
Total	12	100.0	1	100.0	49	100.0	62	100.0

Table 4.10-120 Assessment by medical oncology either pre- or post-surgery by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Medical oncology FSA attended	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	118	64.5	107	60.8	113	60.8	93	60.0	65	51.2	496	60.0	0.2
No	65	35.5	69	39.2	72	38.7	61	39.4	62	48.8	329	39.8	
Unknown	0	0	0	0	1	0.5	1	0.6	0	0	2	0.2	
Total	183	100.0	176	100.0	186	100.0	155	100.0	127	100.0	827	100.0	

Table 4.10-121 Chemotherapy offered either pre- or post-surgery by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Chemotherapy offered	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	111	60.7	100	56.8	104	55.9	82	52.9	57	44.9	454	54.9	0.7
No	72	39.3	76	43.2	81	43.5	72	46.5	69	54.3	370	44.7	
Unknown	0	0	0	0	1	0.5	1	0.6	1	0.8	3	0.4	
Total	183	100.0	176	100.0	186	100.0	155	100.0	127	100.0	827	100.0	

Table 4.10-122 Post-operative chemotherapy regimen by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Chemotherapy regimen	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Capecitabine alone	23	32.4	26	40.0	27	42.2	18	34.0	13	35.1	107	36.9
5FU alone	20	28.2	22	33.8	27	42.2	22	41.5	12	32.4	103	35.5
Capecitabine + oxaliplatin	24	33.8	15	23.1	8	12.5	9	17.0	9	24.3	65	22.4
5FU + oxaliplatin	4	5.6	2	3.1	2	3.1	4	7.5	3	8.1	15	5.2
Total	71	100.0	65	100.0	64	100.0	53	100.0	37	100.0	290	100.0

Table 4.10-123 Post-operative use of oral chemotherapy by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Chemotherapy regimen	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
5FU	47	66.2	41	63.1	35	54.7	27	50.9	22	59.5	172	59.3	0.4
Capecitabine	24	33.8	24	36.9	29	45.3	26	49.1	15	40.5	118	40.7	
Total	71	100.0	65	100.0	64	100.0	53	100.0	37	100.0	290	100.0	

Table 4.10-124 Reason for stopping chemotherapy early by area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	NZ Deprivation Index of residence at time of diagnosis											
	1-2		3-4		5-6		7-8		9-10			
	N	%	N	%	N	%	N	%	N	%	Total	%
Toxicity	18	72.0	14	56.0	15	71.4	9	47.4	6	75.0	62	63.3
Unrelated adverse event, co-morbidity	0	0	3	12.0	1	4.8	2	10.5	0	0	6	6.1
Progression of cancer or recurrence	2	8.0	0	0	0	0	1	5.3	1	12.5	4	4.1
Patient request	1	4.0	4	16.0	2	9.5	4	21.1	0	0	11	11.2
Change of chemotherapy	3	12.0	2	8.0	1	4.8	0	0	0	0	6	6.1
Other	1	4.0	1	4.0	0	0	1	5.3	0	0	3	3.1
Unknown	0	0	1	4.0	2	9.5	2	10.5	1	12.5	6	6.1
Total	25	100.0	25	100.0	21	100.0	19	100.0	8	100.0	98	100.0

Table 4.10-125 Duration of chemotherapyby area deprivation score of the place of residence at the time of diagnosis for patients with non-metastatic rectal cancer

Duration of chemotherapy (chem)		NZ Deprivation Index of residence at time of diagnosis											
		1-2		3-4		5-6		7-8		9-10			
		N	%	N	%	N	%	N	%	N	%	Total	%
Pre-op chemotherapy	Post-op chem												
	At least 24 weeks	4	9.8	1	2.3	4	10.3	3	9.1	3	16.7	15	5.2
	18-23 weeks	13	31.7	18	41.9	18	46.2	12	36.4	6	33.3	67	23.1
	Less than 18 weeks	24	58.5	22	51.2	16	41.0	18	54.5	9	50.0	89	30.7
	Unknown	0	0	2	4.7	1	2.6	0	0	0	0	3	1.0
	Total	41	100.0	43	100.0	39	100.0	33	100.0	18	100.0	174	60.0
Pre-op chemotherapy	Post-op chem												
	At least 24 weeks	13	43.3	7	31.8	9	36.0	12	60.0	7	36.8	48	16.6
	18-23 weeks	10	33.3	9	40.9	10	40.0	3	15.0	6	31.6	38	13.1
	Less than 18 weeks	5	16.7	4	18.2	5	20.0	4	20.0	5	26.3	23	7.9
	Unknown	2	6.7	2	9.1	1	4.0	1	5.0	1	5.3	7	2.4
	Total	30	100.0	22	100.0	25	100.0	20	100.0	19	100.0	116	40.0
	Total	71	100.0	65	100.0	64	100.0	53	100.0	37	100.0	290	100.0

4.10.3.3.4 Ethnicity for rectal cancer

In the extended PIPER cohort there were 563 patients who received radiotherapy, and 11% of these received post-operative radiotherapy.

The proportion of Māori patients who received curative post-operative radiation was 21%, compared with 6% of Pacific and 10% of nMnP patients (p<0.001) (Table 4.10-126). About half of the patients had chemotherapy at the same time as their radiation (Table 4.10-127). The proportions of patients who saw a medical oncologist at any stage in the their treatment were 71% for both Māori patients and Pacific patients, compared with 60% for nMnP, although the difference was not statistically significant (p=0.6) (Table 4.10-128). The proportions offered chemotherapy were also higher for Māori and Pacific patients than nMnP, but not statistically significantly different (p=0.5) (Table 4.10-129). There appeared to be differences in the type of chemotherapy regimen used between Māori, Pacific and nMnP patients (Table 4.10-130) (p=0.0005), the Māori patients having lower proportions on regimens with oxaliplatin. There was a significant difference between the proportions using capecitabine vs. 5FU by ethnicity (0.04), with the proportion of Māori on 5FU being higher than for nMnP (Table 4.10-131). However the planned analyses allowing for differences in age, gender and comorbidity of the patients, along with other disease characteristics, are required before any reliable conclusions can be drawn.

Table 4.10-126 Curative post-operative radiotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Post-operative radiotherapy	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Curative adjuvant	12	21.1	1	5.6	49	10.0	62	11.0	<0.001
Adjuvant, other	0	0	0	0	2	0.4	2	0.4	
No	45	78.9	17	94.4	437	89.5	499	88.6	
Total	57	100.0	18	100.0	488	100.0	563	100.0	

Table 4.10-127 Post-operative chemoradiation by prioritised ethnicity for patients with non-metastatic rectal cancer

Post-operative radiotherapy	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Radiotherapy with chemotherapy	6	50.0	1	100.0	20	40.8	27	43.5
Radiotherapy only	6	50.0	0	0	29	59.2	35	56.5
Total	12	100.0	1	100.0	49	100.0	62	100.0

Table 4.10-128 Assessment by medical oncology either pre- or post-surgery by prioritised ethnicity for patients with non-metastatic rectal cancer

Medical oncology FSA attended	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	62	71.3	24	70.6	509	60.2	595	61.5	0.6
No	23	26.4	10	29.4	330	39.0	363	37.5	
Unknown	2	2.3	0	0	7	0.8	9	0.9	
Total	87	100.0	34	100.0	846	100.0	967	100.0	

Table 4.10-129 Chemotherapy offered either pre- or post-surgery by prioritised ethnicity for patients with non-metastatic rectal cancer

Chemotherapy offered	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	58	66.7	22	64.7	465	55.0	545	56.4	0.5
No	26	29.9	12	35.3	373	44.1	411	42.5	
Unknown	3	3.4	0	0	8	0.9	11	1.1	
Total	87	100.0	34	100.0	846	100.0	967	100.0	

Table 4.10-130 Post-operative chemotherapy regimen by prioritised ethnicity for patients with non-metastatic rectal cancer

Chemotherapy regimen	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Capecitabine alone	13	33.3	6	50.0	114	38.0	133	37.9
5FU alone	22	56.4	0	0	108	36.0	130	37.0
Capecitabine + oxaliplatin	3	7.7	3	25.0	66	22.0	72	20.5
5FU + oxaliplatin	1	2.6	3	25.0	12	4.0	16	4.6
Total	39	100.0	12	100.0	300	100.0	351	100.0

Table 4.10-131 Post-operative use of oral chemotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Chemotherapy regimen	Prioritised ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
5FU	16	41.0	9	75.0	180	60.0	205	58.4	0.04
Capecitabine	23	59.0	3	25.0	120	40.0	146	41.6	
Total	39	100.0	12	100.0	300	100.0	351	100.0	

Table 4.10-132 Reason for stopping chemotherapy early by prioritised ethnicity for patients with non-metastatic rectal cancer

Reason for stopping chemotherapy	Prioritised ethnicity							
	Māori		Pacific		nMnP			
	N	%	N	%	N	%	Total	%
Toxicity	4	44.4	1	25.0	65	65.0	70	61.9
Unrelated adverse event, co-morbidity	0	0	1	25.0	6	6.0	7	6.2
Progression of cancer or recurrence	1	11.1	0	0	5	5.0	6	5.3
Patient request	4	44.4	2	50.0	9	9.0	15	13.3
Change of chemotherapy	0	0	0	0	6	6.0	6	5.3
Other	0	0	0	0	3	3.0	3	2.7
Unknown	0	0	0	0	6	6.0	6	5.3
Total	9	100.0	4	100.0	100	100.0	113	100.0

Table 4.10-133 Duration of chemotherapy by prioritised ethnicity for patients with non-metastatic rectal cancer

Duration of chemotherapy		Prioritised ethnicity							
		Māori		Pacific		nMnP			
		N	%	N	%	N	%	Total	%
Pre-op chemotherapy	Post-op chemo								
	At least 24 weeks	3	12.0	1	20.0	13	7.3	17	4.8
	18-23 weeks	10	40.0	2	40.0	69	39.0	81	23.1
	Less than 18 weeks	12	48.0	2	40.0	92	52.0	106	30.2
	Unknown	0	0	0	0	3	1.7	3	0.9
	Total	25	100.0	5	100.0	177	100.0	207	59.0
No pre-op chemotherapy	Post-op chemo								
	At least 24 weeks	7	50.0	1	14.3	51	41.5	59	16.8
	18-23 weeks	2	14.3	3	42.9	42	34.1	47	13.4
	Less than 18 weeks	5	35.7	3	42.9	21	17.1	29	8.3
	Unknown	0	0	0	0	9	7.3	9	2.6
	Total	14	100.0	7	100.0	123	100.0	144	41.0
	Total	39	100.0	12	100.0	300	100.0	351	100.0

4.10.3.4 Key Points: neoadjuvant and adjuvant therapy for non-metastatic rectal cancer

Overall use of radiotherapy:

- 52% of patients with non-metastatic rectal cancer received radiotherapy (RT), 46% pre-operatively and 5% post operatively.
- Rural patients were more likely to receive radiotherapy (64%) compared to independent urban (54%) and urban patients (49%). The proportions receiving pre- or post-operative RT were not different. Similarly, receipt of radiotherapy increased with increasing distance to health facility of diagnosis. Although this finding will need to be adjusted for age, gender, and comorbidity, prima facie it does not show that rural patients or those with long distance to health facility of diagnosis are missing out on receiving radiotherapy.
- Māori were slightly more likely to receive radiotherapy (63%) compared to Pacific (43%) or nMnP (53%), but also were slightly more likely to receive post-operative treatment (small numbers; n=66 for post-op RT – Māori 19%, PI 6%, nMnP 11%).
- Due to significant limitations with accurately defining pre-op stage, this cannot be adjusted for pre-treatment disease characteristics. Age standardisation will also need to be undertaken to further interpret this finding.

Pre-operative radiotherapy:

- Of standard pre-operative strategies, 18% received short course and 82% received long-course radiotherapy.
- The proportions who received short compared to long-course therapy did not appear to vary according to rurality, ethnicity or distance to health facility of diagnosis.

Pre-operative chemotherapy:

- 85% of people receiving long-course radiotherapy also received chemotherapy, and 85% of those who received chemotherapy completed their course.
- With long-course radiotherapy, 15% did not appear to receive any chemotherapy. Numbers were too small to draw conclusions according to rurality, deprivation, ethnicity or distance to health facility of diagnosis.
- 98% of patients completed the planned duration of long-course radiotherapy.
- Of those receiving chemotherapy, 72% received 5FU and 28% received capecitabine. Rural patients were slightly more likely to receive 5FU than capecitabine compared to urban patients (81% v 69%) which appears to be counter-intuitive. Further analyses will need to be undertaken to understand this finding further. No difference by ethnicity was seen.
- Of those who received chemotherapy with radiotherapy, 85% completed planned chemotherapy. 12% stopped for toxicity, and 3% for other reasons (e.g. unrelated comorbidity, patient request). Total numbers stopping are too small to make comparisons regarding ethnicity or rurality

Assessment by Medical Oncology or Radiation Oncology clinic:

- The proportions of patients who received treatment reflected the proportion who were seen in MO and RO clinics, although as would be expected there is a decrement between the number seen and the number receiving treatment.

Post-operative radiotherapy:

- 10% of patients who had radiotherapy with curative intent received it post-operatively. This represents 5% of all patients with non-metastatic rectal cancer
- Given the small numbers receiving post-operative therapy, no reliable conclusions can be drawn about the influence of ethnicity, rurality, deprivation, or distance to health facility of diagnosis.

Assessment by Medical Oncology:

- 60% of all patients with rectal cancer saw a medical oncologist (either pre- or post-operatively). 92% of patients seen by a medical oncologist received chemotherapy.
- Numbers were small, however there was no major difference in proportion seen by MO according to distance from health facility of diagnosis or ethnicity.
- The most deprived patients were the least likely to be seen by a medical oncologist (51%). The most deprived patients were also the least likely to be offered chemotherapy. This has not been corrected for age, gender, or comorbidity, which are likely confounders.

Adjuvant chemotherapy:

- 35% of patients (291/832) received adjuvant chemotherapy.
- We are unable to control for the effect of pre-op stage, and post-op stage is heavily confounded by pre-treatment strategy therefore this simply reflects the total proportion of patients with non-metastatic rectal cancer whom were treated.
- A slightly higher proportion of rural patients received chemo (40% compared to 35% urban and 32% independent urban). The comparison requires adjustment for age and comorbidity before any conclusions can be made.
- There are no clear trends seen regarding single agent or combination chemotherapy and rurality, although rural patients were least likely to receive a capecitabine-containing regimen.
- Duration of therapy is less easily interpreted, as the optimal duration of therapy post-op remains debated. However only 57% (165/288) of those who received post-op chemo completed 18 weeks or more of therapy. Duration of therapy appeared different according to whether pre-op radiotherapy was received or not, with a higher proportion of patients who received no pre-op radiotherapy completing 24 weeks of chemo.

4.10.3.5 Discussion: neoadjuvant and adjuvant therapy for non-metastatic rectal cancer

Our report shows that 52% of patients with non-metastatic rectal cancer received radiotherapy. This contrasts with the findings from the UK National Bowel Cancer Audit (NBOCAP) where in 2012-2013, 37% of patients with rectal cancer received radiation. The reported proportion receiving radiotherapy in the UK has reduced since 2008, when 43% of patients received radiotherapy, although the NBOCAP 2014 progress report notes that collection of radiotherapy and chemotherapy data for rectal cancer is "very incomplete".[87]

We found that height of tumour from the anal verge and pre-treatment stage were very difficult to identify accurately from clinical records, to the extent where attempting to identify height of tumour from the anal verge had to be aborted as a data collection point during the course of the study. Therefore it is extremely difficult to untangle the impact of treatment strategy on outcome given the heterogeneity of pre-treatment stage.

We also found that post-operative radiotherapy was received by 5% of all patients. This is higher than the UK where 1.1% of patients receive post-operative therapy in 2012-2013. It is not clear that the indication for this was always positive circumferential margin, and it is possible that some patients would have had (chemo)radiotherapy following TEM surgery as an organ preserving approach. Future analyses would be possible according to radiotherapy strategy and involvement of circumferential resection margin (CRM). Given that pre-operative treatment is superior to post-operative treatment, it is potentially of concern. Although reliant on small numbers, it is potentially of concern that Māori were more likely to receive post-operative therapy than Pacific or nMnP. This potentially important finding demands further analysis.

Given that pre-operative short course radiotherapy is standard of care in Europe and its use is supported by the TROG 01.04 study,[84] it was perhaps surprising to see so little short-course used in the NZ context (18% of all pre-operative radiotherapy, compared to 27% in the UK). Long-course chemoradiation will result in more tumour down-sizing than short course followed by immediate surgery, but is also more expensive and potentially has more short-term morbidity. The results of the Stockholm III study comparing short-course radiotherapy followed by immediate or delayed surgery may answer whether an increasing time interval following short-course radiotherapy may also result in tumour down-sizing, and is expected to report shortly.

Given the uncertain evidence for the utilisation of chemotherapy following pre-operative chemoradiotherapy and resection in rectal cancer, it is of interest to note that 35% of those with non-metastatic rectal cancer received adjuvant chemotherapy. Māori were more likely to receive capecitabine-based chemotherapy, and independent urban patients were least likely to receive chemotherapy. These findings cannot be reliably adjusted for pre-treatment stage.

28% of patients who received pre-operative chemotherapy received a capecitabine-based regimen. This is of particular note as capecitabine was not explicitly funded for concomitant administration with radiotherapy in rectal cancer until 1 October 2010. Prior to this, the

formal indication was "advanced gastrointestinal cancer" or patients with poor intravenous access who required substitution for a fluoropyrimidine.

15% of patients did not receive chemotherapy with long-course radiotherapy. Given that concomitant therapy is standard of care, further analysis and stratification for comorbidity will be undertaken to assist in understanding reasons why chemotherapy was not prescribed. This could be related to uncontrolled ischaemic heart disease and exacerbations with 5FU/ capecitabine type therapy.

Without standardising the recording of pre-operative stage, including variables such as height of tumour, T stage, depth of T3 invasion, presence of vascular invasion, and distance to mesorectal fascia, it will continue to be difficult to fully understand the outcomes for non-metastatic rectal cancer in the future. Implementation of standardised MRI reporting and standardised data collection for rectal cancer will assist in interpretation of rectal cancer outcomes and will pave the way for quality improvement.

Highlights: non-metastatic rectal cancer

Neo-adjuvant and Adjuvant therapy

52% of patients with non-metastatic rectal cancer received some form of radiotherapy (pre- or post-op)

Of patients who underwent radiotherapy, most received this pre-operatively (89%)

The majority of pre-operatively radiotherapy was long-course (82% of pre-op radiotherapy)

85% of patients received chemotherapy with long-course radiotherapy

Across any form of pre-op chemotherapy 85% of people finished their course.

5% of all patients receive post-operative radiotherapy

36% of patients receive adjuvant chemotherapy

Less than half of patients completed 24 weeks of chemotherapy overall

4.11 Metastatic colorectal cancer treatment

4.11.1 Key performance indicators (KPIs) for treatment of metastatic CRC

The key performance indicators used for describing the treatment of metastatic CRC in this section are:

- Percentage with primary tumour resected (any stage of journey)
- Proportion with no resection of primary who had a stent or stoma (any stage of journey)
- Proportion receiving chemotherapy (any stage of journey) for metastatic disease and regimen received
- Proportion undergoing resection of liver or lung metastases
- Proportion being discussed at an MDM
- Number of patients who received a targeted therapy.

Patients with CRC may either present with stage I to III disease and subsequently develop metastases or present with stage IV disease (by definition metastatic disease at presentation). Metastatic disease is also referred to as metachronous (subsequent to initial presentation) or synchronous with presentation (stage IV). The results in this section refer to the patients who present with synchronous metastases and are therefore by definition stage IV. The cohort of patients who develop metastases after presenting with earlier stage disease are not addressed in this report. The clinical priority for managing patients with metastatic disease is determining if there is a treatment pathway that is potentially curative or one able to offer an extended period of time disease-free. Failing this, the priority is to determine the best strategy for optimising quality of life adjusted survival – namely identifying patients where active anti-cancer treatment is not of value and, in those where value is envisaged, how treatments might be best tailored to the patient's needs.

Key issues with stage IV colon and rectal cancers significantly overlap and are therefore collectively dealt with in this section.

1. Resection of primary tumour and use of alternatives

In a patient with stage IV disease, if the primary is left in situ it may bleed, obstruct, perforate, or invade adjacent organs. Therefore prior to the advent of active non-surgical therapies, the primary was often resected. Systemic chemotherapy is now known to improve overall survival as well as be active on the primary tumour. Therefore the role of primary tumour resection in patients with stage IV disease and in whom chemotherapy is planned, has been debated.

One meta-analysis of 8 published studies including 1062 patients was performed and concluded that those who underwent palliative resection of the primary had a 6.0 month improvement in median survival and those with primary tumour left in situ were 7.3 times more likely to have a complication from the primary tumour.[88]

Subsequently, a Cochrane Review was performed reviewing 7 studies, 6 of which were analysed in the meta-analysis referred to above. The Cochrane review found no evidence of an

improvement in overall survival and no difference in the risk of complications from the primary tumour.[89]

The authors of the conflicting reports both concluded that prospective studies on the value of primary tumour resection were warranted. The Australasian Gastrointestinal Trials Group and the Colorectal Surgical Society of Australia and NZ attempted to conduct a randomised trial of resection compared to non-resection of the primary tumour in patients with asymptomatic stage IV CRC (the SUPER study). This study closed due to poor accrual. A German group are conducting the SYNCHRONOUS study also to address this issue,[90] and a similar study led by the Dutch CRC Group ref 4 opened to recruitment in July 2012. KPIs 1 and 2 therefore will address the issue of the decision to remove the primary and the subsequent need for other palliative procedures.

2. Use of chemotherapy

The decision not to administer palliative chemotherapy for a patient with metastatic CRC is as important as the decision to treat. There are a multitude of factors (medical and non-medical) that influence this decision which should be made in conjunction with the patient and their family/whanau.

For patients where a decision to treat with chemotherapy is made, this decision will lead to choices of approach including timing, number and drug options.

In patients with stage IV CRC the chemotherapeutic agents 5-fluorouracil (and its related pro-drug capecitabine), irinotecan and oxaliplatin have been shown to extend overall survival.[91-93] The use of either an oxaliplatin-containing or irinotecan-containing regimen as first line therapy showed no significant difference in outcome, provided that patients were switched to the alternate regimen on progression.[94] Two studies have examined up-front fluoropyrimidine monotherapy in order to reduce toxicity and possibly cost without compromising efficacy.[95, 96] These studies demonstrated that sequential single-agent therapy was not worse than combination therapy, however the median overall survival achieved in these studies was lower than in many contemporary studies.

An analysis of 7 published randomised studies found a strong correlation between exposure to all three chemotherapy agents and survival.[97] The authors concluded that a strategy of exposing patients to all three chemotherapeutic agents was the most critical determinant of overall survival rather than sequencing of treatment.

Other agents that are associated with improved survival including regorafenib, bevacizumab, aflibercept, cetuximab, panitumumab and TAS-102 are not available in the public health system in NZ. As limited access to cetuximab and bevacizumab existed during the study period, either through clinical trial or private sector administration, we noted if these were administered.

3. Resection of metastases

Resection of colorectal liver metastases has resulted in a proportion of patients being free of disease for more than 10 years.[98-100] The indications for liver metastatectomy have evolved,

and the criteria for defining resectability are variable between clinician and centre. Some consider the presence of extra-hepatic disease to no longer be an absolute contraindication to surgical resection of liver metastases with curative intent.[101, 102]

Chemotherapy in addition to liver resection, either, before and after (peri-operative, or so called 'sandwich chemo'), or post-operatively has been associated with longer progression free survival with a trend to overall survival although studies have not been powered to detect a significant difference in survival.[100, 103]

Resection of limited pulmonary metastatic disease has been undertaken following the same rationale as for resection of isolated liver metastases. Similarly, no randomised trial of surgery compared to systemic therapy has been undertaken and is unlikely to be initiated. Several single institution series have been reported and demonstrate 30-50% long term survivors, depending on patient characteristics. Meta-analyses also suggest benefit from resection of lung metastases.[104] The role of adjuvant therapy following resection of lung metastases is less certain. One non-randomised comparison published in abstract only found improved survival in patients with resected lung metastases treated with post-operative combination chemotherapy, although the arms were not balanced.

4. Review at a Multi-Disciplinary Meeting

Multidisciplinary cancer team meeting (MDM) discussion is mandated for all newly diagnosed cancers in the United Kingdom. At the time of the PIPER cohort, there was no similar requirement in NZ. However we recorded where there was evidence of MDM discussion and this will enable us to establish whether MDM discussion rates had any impact on cancer outcomes or intervention rates.

4.11.2 Cohort of patients with metastatic colorectal cancer

This section includes all cases classified as having metastatic disease at the time of first staging. For the colon patients this is based on their stage at 8 weeks post resection of the primary, to allow time for staging CT scans; for the rectal patients and those whose site of primary disease is unknown, it is based on the pre-operative stage. Methods used to define stage are described in section 3.2.4.3 (under calculated fields used in the report) and the summary of numbers of patients for colon and rectal patients by stage can be found in Table 4.2-19, Table 4.2-20 and Table 4.2-27. There are 38 colon cancer patients whose pre-operative stage was non-metastatic but with additional staging procedures within 8 weeks post-operatively were reclassified as metastatic. A further 4 colon cancer patients with unknown pre-operative stage were similarly reclassified as metastatic within the 8 week period of surgery and are included in this metastatic CRC cohort. Excluded from the metastatic colorectal analysis are the patients who were initially registered in PIPER with non-metastatic colon or rectal cancer who subsequently relapsed with metastatic disease.

For the metastatic colorectal group the data collected is from their presentation through to the date the hospital record review for that patient was completed. 94% of patients had died by this time, so collection was complete, but for the 6% of patients who were still alive follow-up varied: median 4 years, IQ range (2.4 to 5.3).

Of the 4963 patients diagnosed with CRC in 2007 and 2008, there were 1126 patients with metastatic CRC (23 % of all CRC diagnoses in 2007-2008).

The tables below show the age, gender and co-morbidity distributions for this cohort by rurality of residence at diagnosis, distance from residence to diagnosis facility and NZ deprivation score (Table 4.11-1 to Table 4.11-9). The urban and independent-urban were the most similar with the rural group of patients being younger, having a lower proportion of females and lower co-morbidity scores than the urban and independent-urban groups. The main differences noted for distance from residence to facility of diagnosis is that patients in the 70 and above age groups tended not to be in the group living >50km from the facility of diagnosis and the proportion of females tended to decrease as the distance from residence to facility of diagnosis increases. For deprivation score the main difference seen was that comorbidity tended to be greater with higher deprivation.

Ethnicity was evaluated using the extended cohort (all patients in the main cohort plus all Māori and Pacific patients diagnosed in the calendar years 1 January 2006 – 31 Dec 2006 and 1 Jan 2009 – 31 Dec 2009 and a randomly sampled equal number of nMnP cases (nMnP over the same time frame)). For metastatic CRC, this meant that an additional 181 patients were included in this analysis, giving a total 1307 of patients. The tables below show the age, gender and co-morbidity distributions for this cohort by ethnicity. The age distribution was younger for the Pacific patient group and the Māori group compared to the nMnP group. (Table 4.6-10). The Pacific patient group had a higher proportion of male patients than the Māori and nMnP groups (Table 4.11-11). The Pacific patient group also had a higher proportion with a co-morbidity score of >2 whereas the Māori and nMnP patient groups had similar distributions for the comorbidity score (Table 4.11-12).

Table 4.11-1 Age at diagnosis by rurality of residence at the time of diagnosis for patients with metastatic CRC

	Rurality of residence at time of diagnosis									
Age at diagnosis	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	17	2.2	3	1.6	5	3.5	0	0	25	2.2
40-49	47	6.1	4	2.1	3	2.1	2	12.5	56	5.0
50-59	101	13.0	21	10.9	24	17.0	3	18.8	149	13.2
60-69	191	24.6	60	31.1	54	38.3	6	37.5	311	27.6
70-79	234	30.2	63	32.6	40	28.4	5	31.3	342	30.4
>=80	186	24.0	42	21.8	15	10.6	0	0	243	21.6
Total	776	100.0	193	100.0	141	100.0	16	100.0	1126	100.0

Table 4.11-2 Gender by rurality of residence at the time of diagnosis for patients with metastatic CRC

Gender	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	366	47.2	89	46.1	59	41.8	9	56.3	523	46.4
Male	410	52.8	104	53.9	82	58.2	7	43.8	603	53.6
Total	776	100.0	193	100.0	141	100.0	16	100.0	1126	100.0

Table 4.11-3 C3 Comorbidity score by rurality of residence at the time of diagnosis for patients with metastatic CRC.

C3 comorbidity score	Rurality of residence at time of diagnosis									
	Urban		Independent urban		Rural		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	376	48.5	93	48.2	74	52.5	14	87.5	557	49.5
>0-<1	137	17.7	35	18.1	28	19.9	0	0	200	17.8
1-<2	108	13.9	29	15.0	17	12.1	1	6.3	155	13.8
>2	155	20.0	36	18.7	22	15.6	1	6.3	214	19.0
Total	776	100.0	193	100.0	141	100.0	16	100.0	1126	100.0

Table 4.11-4 Age at diagnosis by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Age at diagnosis	Distance from residence to facility of diagnosis (km)													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	11	2.9	2	0.9	4	2.2	5	2.6	3	2.3	0	0	25	2.2
40-49	22	5.9	10	4.4	12	6.5	8	4.2	2	1.5	2	10.0	56	5.0
50-59	42	11.2	36	15.9	27	14.6	22	11.6	18	13.8	4	20.0	149	13.2
60-69	93	24.7	52	23.0	50	27.0	54	28.6	55	42.3	7	35.0	311	27.6
70-79	118	31.4	67	29.6	59	31.9	60	31.7	31	23.8	7	35.0	342	30.4
>=80	90	23.9	59	26.1	33	17.8	40	21.2	21	16.2	0	0	243	21.6
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	20	100.0	1126	100.0

Table 4.11-5 Gender by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC.

Gender	Distance from residence to facility of diagnosis (km)													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
Female	182	48.4	101	44.7	83	44.9	98	51.9	49	37.7	10	50.0	523	46.4
Male	194	51.6	125	55.3	102	55.1	91	48.1	81	62.3	10	50.0	603	53.6
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	20	100.0	1126	100.0

Table 4.11-6 C3 Comorbidity score by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

C3 comorbidity score	Distance from residence to facility of diagnosis (km)													
	0-<5		5-<10		10-<20		20-<50		50>/=		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
0	173	46.0	109	48.2	99	53.5	91	48.1	69	53.1	16	80.0	557	49.5
>0-<1	76	20.2	34	15.0	31	16.8	35	18.5	23	17.7	1	5.0	200	17.8
1-<2	59	15.7	36	15.9	19	10.3	26	13.8	14	10.8	1	5.0	155	13.8
>2	68	18.1	47	20.8	36	19.5	37	19.6	24	18.5	2	10.0	214	19.0
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	20	100.0	1126	100.0

Table 4.11-7 Age at diagnosis by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

Age at diagnosis	NZ Deprivation Index of residence at time of diagnosis													
	1-2		3-4		5-6		7-8		9-10		Unknown			
	N	%	N	%	N	%	N	%	N	%	N	%	Total	%
<40	7	3.1	4	1.9	3	1.2	8	3.7	3	1.5	0	0	25	2.2
40-49	16	7.1	8	3.8	12	4.9	5	2.3	13	6.4	2	8.7	56	5.0
50-59	34	15.0	24	11.4	32	13.1	25	11.4	31	15.3	3	13.0	149	13.2
60-69	73	32.3	60	28.4	66	26.9	61	27.9	45	22.3	6	26.1	311	27.6
70-79	65	28.8	72	34.1	72	29.4	66	30.1	60	29.7	7	30.4	342	30.4
>=80	31	13.7	43	20.4	60	24.5	54	24.7	50	24.8	5	21.7	243	21.6
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	23	100.0	1126	100.0

Table 4.11-8 Gender by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

	NZ Deprivation Index of residence at time of diagnosis													
Gender	**1-2**		**3-4**		**5-6**		**7-8**		**9-10**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
Female	89	39.4	108	51.2	121	49.4	99	45.2	93	46.0	13	56.5	523	46.4
Male	137	60.6	103	48.8	124	50.6	120	54.8	109	54.0	10	43.5	603	53.6
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	23	100.0	1126	100.0

Table 4.11-9 C3 Comorbidity score by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

	NZ Deprivation Index of residence at time of diagnosis													
C3 comorbidity score	**1-2**		**3-4**		**5-6**		**7-8**		**9-10**		**Unknown**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**
0	126	55.8	100	47.4	132	53.9	103	47.0	81	40.1	15	65.2	557	49.5
>0-<1	40	17.7	45	21.3	37	15.1	34	15.5	43	21.3	1	4.3	200	17.8
1-<2	27	11.9	28	13.3	35	14.3	31	14.2	31	15.3	3	13.0	155	13.8
>2	33	14.6	38	18.0	41	16.7	51	23.3	47	23.3	4	17.4	214	19.0
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	23	100.0	1126	100.0

Table 4.11-10 Age at diagnosis by prioritised ethnicity for patients with metastatic CRC

Age at diagnosis	Prioritised Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
<40	7	4.8	3	6.5	24	2.2	0	0	34	2.6
40-49	14	9.6	6	13.0	48	4.3	0	0	68	5.2
50-59	36	24.7	14	30.4	140	12.6	0	0	190	14.5
60-69	53	36.3	9	19.6	302	27.1	1	100.0	365	27.9
70-79	30	20.5	8	17.4	349	31.3	0	0	387	29.6
>=80	6	4.1	6	13.0	251	22.5	0	0	263	20.1
Total	146	100.0	46	100.0	1114	100.0	1	100.0	1307	100.0

Table 4.11-11 Gender by prioritised ethnicity for patients with metastatic CRC

Gender	Prioritised Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
Female	62	42.5	17	37.0	516	46.3	1	100.0	596	45.6
Male	84	57.5	29	63.0	598	53.7	0	0	711	54.4
Total	146	100.0	46	100.0	1114	100.0	1	100.0	1307	100.0

Table 4.11-12 C3 Comorbidity score by prioritised ethnicity for patients with metastatic CRC

C3 comorbidity score	Prioritised Ethnicity									
	Māori		Pacific		nMnP		Unknown			
	N	%	N	%	N	%	N	%	Total	%
0	75	51.4	22	47.8	551	49.5	1	100.0	649	49.7
>0-<1	24	16.4	8	17.4	195	17.5	0	0	227	17.4
1-<2	22	15.1	2	4.3	155	13.9	0	0	179	13.7
>2	25	17.1	14	30.4	213	19.1	0	0	252	19.3
Total	146	100.0	46	100.0	1114	100.0	1	100.0	1307	100.0

4.11.3 Rurality of residence at diagnosis for metastatic CRC

Of the 1126 patients with metastatic CRC, 16 had unknown rurality status. Those with rurality unknown are not included in the tables describing rurality, leaving 1110 patients.

All surgical operations recorded in the PIPER data were used to ascertain whether a patient had an operation for the removal of their primary or not. This included operations and data on whether the primary was resected in the initial management period and operations collected after the patient had documented progressive disease. Overall 52% (95% CI:49 to 55) of patients with metastatic CRC had their primary removed (Table 4.11-13). Patients in rural areas had the highest proportion with their primary removed (55% versus 51% for urban and 52% for independent urban), but the differences were not statistically significant (p=0.9)

All surgical operations recorded in the PIPER data were used to ascertain whether or not a patient had an operation for formation of a stoma. This included operations in the initial management period and operations collected after the patient had documented progressive disease. The overall proportion of patients who had a stoma formed was 17% (95% CI: 14 to 20). Patients in rural areas had the highest proportion with a stoma formed (31%), compared with independent urban (21%) and urban (13%) (p=<0.0009; Table 4.11-14).

Whether a patient had a insertion of a stent was ascertained in the same way described for the formation of stoma above. The overall proportion of patients who had a stent formed was 8% (95% CI: 5 to 10). Patients in the independent urban group had the lowest proportion with a stent (6%), compared with urban (8%) and rural (8%), although the differences were not statistically significant (p=0.7; Table 4.11-15). It is possible that both stoma formation and stent insertion were underestimated due to movement of patients between hospitals.

Information on site of metastatic disease at both initial diagnosis and diagnosis of recurrent disease was used to determine sites of metastatic disease. Overall 42% had liver only as their site of metastatic disease (95% CI:40 to 45). The proportions with metastatic disease in either liver only or lung only were similar for the three rurality groups. (Table 4.11-16). However it should be noted that there were 10% with unknown site of metastatic disease at initial diagnosis.

All surgical operations recorded in the PIPER data were used to ascertain whether a patient had an operation for liver or lung resection. Overall 7% (95% CI: 6 to 9) of patients had either their lung or liver resected (Table 4.11-17). The rural patient group had the highest proportion of liver or lung resection (11%) compared to the urban (7%) and independent urban (5%), although the difference is not statistically significant (p=0.2).

In this initial stage of analysis we have presented crude proportions, which do not take account of the variable follow-up time for the 6% of patients still alive at data collection. The next stage of analysis will use survival analysis methods to address any possible bias.

Table 4.11-13 Surgery for removal of primary disease by rurality of residence at the time of diagnosis for patients with metastatic CRC

Primary removed	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	395	50.9	100	51.8	77	54.6	572	51.5	0.9
No	358	46.1	88	45.6	64	45.4	510	45.9	
Unknown	23	3.0	5	2.6	0	0	28	2.5	
Total	776	100.0	193	100.0	141	100.0	1110	100.0	

Table 4.11-14 Stoma formed by rurality of residence at the time of diagnosis for patients with metastatic CRC

Stoma	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	47	13.1	18	20.5	20	31.3	85	16.7	0.0009
No	311	86.9	70	79.5	44	68.8	425	83.3	
Total	358	100.0	88	100.0	64	100.0	510	100.0	

Table 4.11-15 Stent insertion by rurality of residence at the time of diagnosis for patients with metastatic CRC

Stent	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	29	8.1	5	5.7	5	7.8	39	7.6	0.7
No	329	91.9	83	94.3	59	92.2	471	92.4	
Total	358	100.0	88	100.0	64	100.0	510	100.0	

Table 4.11-16 Site of metastatic disease by rurality of residence at the time of diagnosis for patients with metastatic CRC

Site of metastatic disease	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Liver and Lung	122	15.7	25	13.0	21	14.9	168	15.1	0.9
Liver	328	42.3	77	39.9	59	41.8	464	41.8	
Lung	31	4.0	8	4.1	4	2.8	43	3.9	
Other	263	33.9	71	36.8	54	38.3	388	35.0	
Unknown	32	4.1	12	6.2	3	2.1	47	4.2	
Total	776	100.0	193	100.0	141	100.0	1110	100.0	

Table 4.11-17 Operation for liver or lung resection by rurality of residence at the time of diagnosis for patients with metastatic CRC.

Liver or Lung resection	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Liver	49	6.3	9	4.7	14	9.9	72	6.5	0.2
Lung	5	0.6	2	1.0	1	0.7	8	0.7	
No liver or lung	722	93.0	182	94.3	126	89.4	1030	92.8	
Total	776	100.0	193	100.0	141	100.0	1110	100.0	

All data on chemotherapy recorded in the PIPER data were used to ascertain whether metastatic patients had any chemotherapy treatment. Overall 50% (95% CI: 46 to 53) of patients received some chemotherapy, with those in the rural areas more likely to have received chemotherapy (63%) compared to the urban (48%) and independent urban (46%) (p=0.003; Table 4.11-18). These results may be affected by the fact the rural group tended to be younger and have fewer comorbidities than the urban and independent urban patient groups. Further analysis of these results will be carried out in the second phase where the effects of age, gender and comorbidity will addressed.

Whether patients had radiotherapy treatment or not was ascertained using all the PIPER data on radiotherapy. The overall proportion of patients receiving radiotherapy was 18% (95% CI: 16 to 21). The highest proportion receiving radiotherapy was in the rural areas (23%) compared with urban areas (18%) and independent urban (15%), although the differences were not statistically significant (p=0.1; Table 4.11-19).

The overall proportion of patients with metastatic CRC who were reviewed at an MDM was 59% (95% CI: 56 to 61). The proportion was highest in the rural group (67%) compared with 61% in the independent urban group and 56% in the urban group, but the difference was not statistically significant (p=0.2; Table 4.11-20).

Table 4.11-18 Chemotherapy treatment by rurality of residence at the time of diagnosis for patients with metastatic CRC

Any chemotherapy treatment	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	370	47.7	88	45.6	88	62.4	546	49.2	0.003
No	375	48.3	99	51.3	47	33.3	521	46.9	
Unknown	31	4.0	6	3.1	6	4.3	43	3.9	
Total	776	100.0	193	100.0	141	100.0	1110	100.0	

Table 4.11-19 Radiotherapy treatment by rurality of residence at the time of diagnosis for patients with metastatic CRC

Any radiotherapy treatment	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
Yes	140	18.0	28	14.5	33	23.4	201	18.1	0.1
No	604	77.8	156	80.8	103	73.0	863	77.7	
Unknown	32	4.1	9	4.7	5	3.5	46	4.1	
Total	776	100.0	193	100.0	141	100.0	1110	100.0	

Table 4.11-20 Review at colorectal multidisciplinary meeting by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

MDM review	Rurality of residence at time of diagnosis								
	Urban		Independent urban		Rural				
	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	11	1.4	1	0.5	5	3.5	17	1.5	0.2
8-0 weeks before first treatment	118	15.2	24	12.4	16	11.3	158	14.2	
Within 4 weeks after first treatment	51	6.6	15	7.8	5	3.5	71	6.4	
Within 4-8 weeks after first treatment	9	1.2	0	0	3	2.1	12	1.1	
Within 8-12 weeks after first treatment	8	1.0	1	0.5	0	0	9	0.8	
No	438	56.4	117	60.6	94	66.7	649	58.5	
Unknown	141	18.2	35	18.1	18	12.8	194	17.5	
Total	776	100.0	193	100.0	141	100.0	1110	100.0	

*p-value calculated between MDM with time frame 26 weeks prior to 12 weeks post first treatment

4.11.4 Distance from residence at diagnosis to facility of diagnosis for metastatic CRC

There were 1126 patients with metastatic CRC, for 20 of these the distance from their residence to the health facility of diagnosis was unknown, leaving 1106 available for analysis.

The overall proportion of patients who had their primary removed was 51%. There was some variation by distance from the diagnostic facility (48% - 55%), but it was not statistically significantly different (p=0.7; Table 4.11-21).

The proportion of patients having a stoma formed was higher in the group living over 50km from the facility of diagnosis (24%) and the group living 20-50km away (19%) compared to the groups living within 20km of the diagnostic facility (14-15%), but the differences were not statistically significant (p=0.6;Table 4.11-22). There was some variation in the proportion having a stent with the proportions varying from (6-10%), but there were no obvious patterns (p=0.7; Table 4.11-23).

There were no obvious patterns between distance from diagnostic facility and the site of metastatic disease (p=0.7). Overall the proportion where the site of metastatic disease was liver and lung was 15%, liver only was 42% and lung only was 4% (Table 4.11-24). The overall proportion having a liver and/or lung resection was small (7%) and there were no obvious patterns in relation to the distance from place of residence at diagnosis to facility of diagnosis (Table 4.11-25). A higher proportion of patients received chemotherapy in the group living over 50km from the health facility of diagnosis (64%) compared with those living less than 50km away (44%-49%)(p=0.007; Table 4.11-26). This could be influenced by the group living over 50km away tending to be younger. This will be explored further in the second phase of analysis that will address the effects of age, gender and comorbidity. There were some differences in the proportion of patients receiving radiotherapy, with patient group living over 20kms away having higher proportions (21%-22%) than those living closer (16-18%), but it was not statistically significant (p=0.4; Table 4.11-27).

The proportions of patients reviewed at an MDM varied from 55% to 62%, but there was no clear pattern and the differences were not statistically significant (p=0.2).

Table 4.11-21 Surgery for removal of primary disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Primary removed	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	191	50.8	108	47.8	101	54.6	103	54.5	66	50.8	569	51.4	0.7
No	176	46.8	111	49.1	83	44.9	81	42.9	59	45.4	510	46.1	
Unknown	9	2.4	7	3.1	1	0.5	5	2.6	5	3.8	27	2.4	
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	1106	100.0	

Table 4.11-22 Stoma formed by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Stoma	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	27	15.3	16	14.4	13	15.7	15	18.5	14	23.7	85	16.7	0.6
No	149	84.7	95	85.6	70	84.3	66	81.5	45	76.3	425	83.3	
Total	176	100.0	111	100.0	83	100.0	81	100.0	59	100.0	510	100.0	

Table 4.11-23 Stent insertion by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

	Distance from residence to facility of diagnosis (km)												
Stent	**0-<5**		**5-<10**		**10-<20**		**20-<50**		**50>/=**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Yes	17	9.7	7	6.3	5	6.0	7	8.6	3	5.1	39	7.6	0.7
No	159	90.3	104	93.7	78	94.0	74	91.4	56	94.9	471	92.4	
Total	176	100.0	111	100.0	83	100.0	81	100.0	59	100.0	510	100.0	

Table 4.11-24 Site of metastatic disease by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Site of metastatic disease	Distance from residence to facility of diagnosis (km)												
	0-<5		**5-<10**		**10-<20**		**20-<50**		**50>/=**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Liver and Lung	59	15.7	30	13.3	28	15.1	33	17.5	17	13.1	167	15.1	0.7
Liver	162	43.1	96	42.5	77	41.6	81	42.9	46	35.4	462	41.8	
Lung	13	3.5	7	3.1	10	5.4	5	2.6	8	6.2	43	3.9	
Other	122	32.4	86	38.1	63	34.1	66	34.9	50	38.5	387	35.0	
Unknown	20	5.3	7	3.1	7	3.8	4	2.1	9	6.9	47	4.2	
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	1106	100.0	

Table 4.11-25 Operation for liver or lung resection by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Liver or Lung resection	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Liver	16	4.3	18	8.0	19	10.3	10	5.3	9	6.9	72	6.5	0.999
Lung	3	0.8	0	0	2	1.1	2	1.1	1	0.8	8	0.7	
No liver or lung	357	94.9	208	92.0	164	88.6	177	93.7	120	92.3	1026	92.8	
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	1106	100.0	

Table 4.11-26 Chemotherapy treatment by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Any chemotherapy treatment	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	180	47.9	99	43.8	90	48.6	91	48.1	83	63.8	543	49.1	0.007
No	184	48.9	119	52.7	90	48.6	89	47.1	39	30.0	521	47.1	
Unknown	12	3.2	8	3.5	5	2.7	9	4.8	8	6.2	42	3.8	
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	1106	100.0	

Table 4.11-27 Radiotherapy treatment by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

Any radiotherapy treatment	Distance from residence to facility of diagnosis (km)												
	0-<5		5-<10		10-<20		20-<50		50>/=				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	61	16.2	41	18.1	30	16.2	40	21.2	29	22.3	201	18.2	0.4
No	303	80.6	179	79.2	148	80.0	141	74.6	91	70.0	862	77.9	
Unknown	12	3.2	6	2.7	7	3.8	8	4.2	10	7.7	43	3.9	
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	1106	100.0	

Table 4.11-28 Review at colorectal multidisciplinary meeting by distance of residence at the time of diagnosis from the health facility where the diagnosis was made for patients with metastatic CRC

	Distance from residence to facility of diagnosis (km)												
MDM review	**0-<5**		**5-<10**		**10-<20**		**20-<50**		**50>/=**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
26-8 weeks before first treatment	7	1.9	3	1.3	1	0.5	3	1.6	3	2.3	17	1.5	0.2
8-0 weeks before first treatment	56	14.9	37	16.4	17	9.2	25	13.2	21	16.2	156	14.1	
Within 4 weeks after first treatment	18	4.8	16	7.1	10	5.4	16	8.5	11	8.5	71	6.4	
Within 4-8 weeks after first treatment	3	0.8	2	0.9	3	1.6	3	1.6	1	0.8	12	1.1	
Within 8-12 weeks after first treatment	3	0.8	4	1.8	1	0.5	1	0.5	0	0	9	0.8	
No	223	59.3	125	55.3	115	62.2	110	58.2	76	58.5	649	58.7	
Unknown	66	17.6	39	17.3	38	20.5	31	16.4	18	13.8	192	17.4	
Total	376	100.0	226	100.0	185	100.0	189	100.0	130	100.0	1106	100.0	

*p-value calculated between MDM with time frame 26 weeks prior to 12 weeks post first treatment

4.11.5 Area deprivation of residence at diagnosis for metastatic CRC

Of the 1103 patients with metastatic CRC, 28 had unknown deprivation status.

For the surgical removal of the primary there is a small decrease in the proportion with increasing deprivation (1-2; 56% vs 9-10; 48%)(Table 4.11-29). However the differences were not statistically significant (p=0.6).

Patients from areas with a deprivation score of 3-4 at diagnosis had a smaller proportion with operations for the formation of stoma (9%) than for all other deprivation groups (17%), although not it was not statistically significant (p=0.2; Table 4.11-30). Similarly there were small differences in the proportion of patients having a stent, with the deprivation groups 1-2 and 5-6 having the highest proportions (both 12%) compared with the deprivation groups 3-4, 7-8 and 9-10 (5%, 6%, 4% respectively)Table 4.11-31). Ascertaining the completeness of this data was difficult given the complexity of the data collection for this patient group.

There were differences in the site of metastatic disease between the deprivation groups, however there were no obvious patterns and the differences were not statistically significant. For liver and lung the proportions varied from 14% to 18%, for liver only the proportions were 38% to 44% and for lung only the proportions were 3% to 6%. (p=0.5)(Table 4.11-32). Some differences were observed in the proportions of patients with liver and/or lung resections between the deprivation groups, with the highest proportion of both liver an lung resections seen in the least deprived (1-2; 13%) and then a slight decrease with increasing deprivation in remaining groups (3-4; 7%, 5-6; 6%, 7-8 6%, 9-10; 4%)(Table 4.11-33; p=0.005). This may be partially due to differences in the characteristics of the patients by deprivation, in particular the C3 comorbidity score increases with deprivation and is likely to impact on whether a patient has an operation for a resection or not. This will be explored more in the next phase of the analysis.

For patients receiving chemotherapy treatment the proportions receiving any chemotherapy were lower for areas with higher deprivation (1-2; 65% vs 9-10; 42%)(Table 4.11-34; p=0.0001). The proportion of patients receiving radiotherapy also differed with deprivation. However the pattern is less clear with the highest proportions seen in the least deprived (25%) compared with all other groups (3-4; 17%, 5-6; 14%, 7-8 19%, 9-10; 19%)(Table 4.11-35; p=0.03). For both chemotherapy and radiotherapy the differences in proportions by deprivation are statistically significant. Further investigation of these results will be undertaken where adjustments for patient characteristics such as age, comorbidity score will be included in the analysis.

The proportions of patients who were reviewed at an MDM were very similar for all the deprivation quintiles (p=0.5).

Table 4.11-29 Surgery for removal of primary disease by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

Primary removed	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	126	55.8	109	51.7	126	51.4	110	50.2	97	48.0	568	51.5	0.6
No	93	41.2	101	47.9	112	45.7	104	47.5	97	48.0	507	46.0	
Unknown	7	3.1	1	0.5	7	2.9	5	2.3	8	4.0	28	2.5	
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	1103	100.0	

Table 4.11-30 Stoma formed by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

Stoma	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	17	18.3	9	8.9	22	19.6	19	18.3	17	17.5	84	16.6	0.2
No	76	81.7	92	91.1	90	80.4	85	81.7	80	82.5	423	83.4	
Total	93	100.0	101	100.0	112	100.0	104	100.0	97	100.0	507	100.0	

Table 4.11-31 Stent insertion by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

	NZ Deprivation Index of residence at time of diagnosis												
Stent	**1-2**		**3-4**		**5-6**		**7-8**		**9-10**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Yes	11	11.8	5	5.0	13	11.6	6	5.8	4	4.1	39	7.7	0.09
No	82	88.2	96	95.0	99	88.4	98	94.2	93	95.9	468	92.3	
Total	93	100.0	101	100.0	112	100.0	104	100.0	97	100.0	507	100.0	

Table 4.11-32 Site of metastatic disease by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

	NZ Deprivation Index of residence at time of diagnosis												
Site of metastatic disease	**1-2**		**3-4**		**5-6**		**7-8**		**9-10**				
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Liver and Lung	35	15.5	29	13.7	33	13.5	40	18.3	31	15.3	168	15.2	0.5
Liver	98	43.4	93	44.1	102	41.6	91	41.6	76	37.6	460	41.7	
Lung	13	5.8	5	2.4	8	3.3	12	5.5	5	2.5	43	3.9	
Other	76	33.6	76	36.0	87	35.5	67	30.6	79	39.1	385	34.9	
Unknown	4	1.8	8	3.8	15	6.1	9	4.1	11	5.4	47	4.3	
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	1103	100.0	

Table 4.11-33 Operation for liver or lung resection by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

Liver or Lung resection	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Liver	26	11.5	12	5.7	13	5.3	12	5.5	8	4.0	71	6.4	0.005
Lung	3	1.3	2	0.9	2	0.8	1	0.5	0	0	8	0.7	
No liver or lung	197	87.2	197	93.4	230	93.9	206	94.1	194	96.0	1024	92.8	
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	1103	100.0	

Table 4.11-34 Chemotherapy treatment by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

Any chemotherapy treatment	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	146	64.6	106	50.2	114	46.5	94	42.9	84	41.6	544	49.3	<0.0001
No	71	31.4	97	46.0	123	50.2	118	53.9	107	53.0	516	46.8	
Unknown	9	4.0	8	3.8	8	3.3	7	3.2	11	5.4	43	3.9	
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	1103	100.0	

Table 4.11-35 Radiotherapy treatment by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

Any radiotherapy treatment	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
Yes	56	24.8	35	16.6	33	13.5	37	16.9	38	18.8	199	18.0	0.03
No	160	70.8	169	80.1	201	82.0	173	79.0	155	76.7	858	77.8	
Unknown	10	4.4	7	3.3	11	4.5	9	4.1	9	4.5	46	4.2	
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	1103	100.0	

Table 4.11-36 Review at colorectal multidisciplinary meeting by area deprivation score for residence at the time of diagnosis for patients with metastatic CRC

MDM review	NZ Deprivation Index of residence at time of diagnosis												
	1-2		3-4		5-6		7-8		9-10				
	N	%	N	%	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	5	2.2	2	0.9	5	2.0	3	1.4	2	1.0	17	1.5	0.5
8-0 weeks before first treatment	37	16.4	28	13.3	38	15.5	28	12.8	27	13.4	158	14.3	
Within 4 weeks after first treatment	16	7.1	12	5.7	16	6.5	13	5.9	13	6.4	70	6.3	
Within 4-8 weeks after first treatment	1	0.4	5	2.4	2	0.8	3	1.4	1	0.5	12	1.1	
Within 8-12 weeks after first treatment	3	1.3	1	0.5	2	0.8	0	0	2	1.0	8	0.7	
No	126	55.8	131	62.1	141	57.6	133	60.7	117	57.9	648	58.7	
Unknown	38	16.8	32	15.2	41	16.7	39	17.8	40	19.8	190	17.2	
Total	226	100.0	211	100.0	245	100.0	219	100.0	202	100.0	1103	100.0	

*p-value calculated between MDM with time frame 26 weeks prior to 12 weeks post first treatment

4.11.6 Ethnicity for metastatic CRC

In the extended PIPER cohort there were 1307 patients with metastatic CRC; 1 patient with unknown ethnicity was excluded leaving 1306 for the analyses in this section.

The proportion of Māori having a surgical procedure for the removal of the primary was 48%, compared with Pacific 54% and nMnP 51% (Table 4.11-37). These proportions are not statistically significantly different (p=0.7), however the numbers, in particular in the Pacific group, are small (n=46). For operations for the formation of a stoma the nMnP group had fewer operations (16%) compared with Māori (24%) and Pacific (25%) (p=0.2)(Table 4.11-38). Again these difference are not significant but the numbers are smaller than for the removal of the primary as these proportions are presented only for patients who did not have an operation for the removal of their primary (Māori n=48, Pacific n=54, nMnP=51). The proportion of Māori and nMnP having an operation for a stent is similar (7% vs 8%)(Table 4.11-39). No Pacific patients with metastatic CRC had an operation for a stent insertion, but the numbers are very small.

There were some differences in the site of metastatic disease, but these differences were not significantly different (p=0.09). The Pacific group had a smaller proportion with liver metastases only (26%) compared with Māori (37%) and nMnP (44%). The Pacific group had slightly higher proportion with lung metastases only (9%) compared with Māori (5%) and nMnP (4%) (Table 4.11-40). The overall proportions who had liver and/or lung resection were small (liver 6% ; lung 1%) and with such small numbers in the groups no patterns by ethnicity can be seen (Table 4.11-41).

The proportions receiving any chemotherapy in this metastatic CRC group were similar in the three ethnic groups (Māori 51%, Pacific 46% and nMnP 49%; p=0.7; Table 4.11-42). A higher proportion of Pacific (33%) patients received any form of radiotherapy treatment compared with Māori (24%) and nMnP (17%)(Table 4.11-43; p=0.006). However with such small numbers in the Pacific group any further analysis to explore whether factors such as the site of disease plays a role will be difficult.

The proportions of patients who were reviewed at an MDM were 56% for Māori, 52% for Pacific and 59% for nMnP; there was no statistically significant difference (p=0.2)

Table 4.11-37 Surgery for removal of primary disease by prioritised ethnicity for patients with metastatic CRC

Primary removed	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	70	47.9	25	54.3	569	51.1	664	50.8	0.7
No	71	48.6	20	43.5	517	46.4	608	46.6	
Unknown	5	3.4	1	2.2	28	2.5	34	2.6	
Total	146	100.0	46	100.0	1114	100.0	1306	100.0	

Table 4.11-38 Stoma formed by prioritised ethnicity for patients with metastatic CRC

	Prioritised Ethnicity								
Stoma	**Māori**		**Pacific**		**nMnP**				
	N	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Yes	17	23.9	5	25.0	85	16.4	107	17.6	0.2
No	54	76.1	15	75.0	432	83.6	501	82.4	
Total	71	100.0	20	100.0	517	100.0	608	100.0	

Table 4.11-39 Stent insertion by prioritised ethnicity for patients with metastatic CRC

	Prioritised Ethnicity								
Stent	**Māori**		**Pacific**		**nMnP**				
	N	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Yes	5	7.0	0	0	43	8.3	48	7.9	0.4
No	66	93.0	20	100.0	474	91.7	560	92.1	
Total	71	100.0	20	100.0	517	100.0	608	100.0	

Table 4.11-40 Site of metastatic disease by prioritised ethnicity for patients with metastatic CRC.

	Prioritised Ethnicity								
Site of metastatic disease	**Māori**		**Pacific**		**nMnP**				
	N	**%**	**N**	**%**	**N**	**%**	**Total**	**%**	**p-value**
Liver and Lung	19	13.0	8	17.4	163	14.6	190	14.5	0.09
Liver	54	37.0	12	26.1	488	43.8	554	42.4	
Lung	8	5.5	4	8.7	40	3.6	52	4.0	
Other	58	39.7	20	43.5	376	33.8	454	34.8	
Unknown	7	4.8	2	4.3	47	4.2	56	4.3	
Total	146	100.0	46	100.0	1114	100.0	1306	100.0	

Table 4.11-41 Operation for liver or lung resection by prioritised ethnicity for patients with metastatic CRC

Liver or Lung resection	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Liver	6	4.1	2	4.3	71	6.4	79	6.0	0.4
Lung	0	0	1	2.2	7	0.6	8	0.6	
No liver or lung	140	95.9	43	93.5	1036	93.0	1219	93.3	
Total	146	100.0	46	100.0	1114	100.0	1306	100.0	

Table 4.11-42 Chemotherapy treatment by prioritised ethnicity for patients with metastatic CRC

Any chemotherapy treatment	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	75	51.4	21	45.7	541	48.6	637	48.8	0.7
No	64	43.8	24	52.2	528	47.4	616	47.2	
Unknown	7	4.8	1	2.2	45	4.0	53	4.1	
Total	146	100.0	46	100.0	1114	100.0	1306	100.0	

Table 4.11-43 Radiotherapy treatment by prioritised ethnicity for patients with metastatic CRC

Any radiotherapy treatment	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
Yes	35	24.0	15	32.6	192	17.2	242	18.5	0.006
No	105	71.9	30	65.2	870	78.1	1005	77.0	
Unknown	6	4.1	1	2.2	52	4.7	59	4.5	
Total	146	100.0	46	100.0	1114	100.0	1306	100.0	

Table 4.11-44 Review at colorectal multidisciplinary meeting by prioritised ethnicity for patients with metastatic CRC

MDM review	Prioritised Ethnicity								
	Māori		Pacific		nMnP				
	N	%	N	%	N	%	Total	%	p-value
26-8 weeks before first treatment	2	1.4	1	2.2	18	1.6	21	1.6	0.2
8-0 weeks before first treatment	27	18.5	6	13.0	150	13.5	183	14.0	
Within 4 weeks after first treatment	9	6.2	5	10.9	68	6.1	82	6.3	
Within 4-8 weeks after first treatment	3	2.1	1	2.2	15	1.3	19	1.5	
Within 8-12 weeks after first treatment	2	1.4	1	2.2	7	0.6	10	0.8	
No	81	55.5	24	52.2	660	59.2	765	58.6	
Unknown	22	15.1	8	17.4	196	17.6	226	17.3	
Total	146	100.0	46	100.0	1114	100.0	1306	100.0	

*p-value calculated between MDM with time frame 26 weeks prior to 12 weeks post first treatment

4.11.7 Key points: treatment of metastatic CRC

Demographic characteristics:

- Rural patients presenting with metastatic CRC, like the overall PIPER cohort, appeared to be younger, to have to a greater proportion of males, and have a lower levels of comorbidity than urban and independent urban patients.
- Māori tended to be younger, but had similar levels of comorbidity to the nMnP patients
- Overall 50% of metastatic CRC patients had a comorbidity score of zero.

Resection of primary, stoma formation and stents:

- Overall 52% of patients with metastatic disease had their primary resected
- Most patients who did not have their primary removed did not have a stoma (83%)
- Stoma formation in patients with metastatic disease and primary in situ was more common in rural than urban patients (31% vs. 13%; p=0.0009)
- Stent insertion for an obstructed in-situ primary was performed in 8% of patients.
- Patients residing in low (1-2) NZDep Index areas were more likely to have had a stent placed than those in high (9-10) NZDep Index areas (12% vs. 4%; p=0.009)

Site of metastatic disease:

- The distribution of sites of metastatic disease was: liver 42%; liver & lung 15%; lung 4%. There were no clear differences by rurality, ethnicity or deprivation.
- Overall 7% of patients had a liver resection and 1% of patients had a lung resection, with no clear differences by ethnicity, distance or rurality. However, patients residing in areas of low deprivation (NZDep Index 1-2) had a higher proportion with liver resection than those in the higher deprivation regions (12 vs. 7-4%; overall p=0.005).

Chemotherapy:

- Overall only 49% of stage IV patients with CRC received chemotherapy
- Rural patients were more likely to receive chemotherapy than urban patients (62% vs. 48%; p=0.003)
- Patients living close to the diagnostic facility (within 5km) were less likely to get chemotherapy than those living over 50km away (48% vs. 64%; p=0.007)
- Patients residing in areas with low deprivation (1-2) were more likely given chemotherapy than patients from areas of high deprivation high (9-10) (65 vs. 42%; p<0.0001)
- There were no clear trends in the proportion of patients receiving chemotherapy by ethnicity

Radiotherapy:

- Radiotherapy was used in 19% of patients with metastatic disease during the course of their disease
- Pacific patients were more likely to have RT (33% vs. 17% for Māori and 24% for nMnP; p=0.006)

MDM:

- Evidence of MDM discussion was recorded for 16% of patients prior to first treatment, and there is no evidence in the clinical records of MDM discussion for 76% of patients.

4.11.8 Discussion: treatment of metastatic CRC

The group of patients presenting with metastatic CRC appear to have the same comparative features as the overall PIPER population; rural patients appear to be younger, have a greater proportion of males, and have a lower levels of comorbidity than urban and independent urban patients. Māori patients tend to be younger, but have similar levels of comorbidity to the nMnP patients.

The key prognostic factor in advanced cancer is the measure of performance status measured on a 5 point scale (ECOG; Eastern Cooperative Oncology Group) or as a percentage (Karnofsky Performance Status; KPS). This factor is used widely in cancer medicine, however this study, in its pilot stage, identified that that retrievable documentation of this score is extremely poor and so its collection was ceased. This needs to be addressed going forward as it's not possible to extrapolate from other factors such as comorbidity (50% of stage IV patients have a comorbidity score of zero) or age (20% patients aged 80 or over) when determining appropriateness of decision-making regarding treatment.

Overall 52% of patients with metastatic disease at presentation had their primary resected. Stoma formation in patients with stage IV disease and primary in situ was more common in rural than urban patients (31% vs 13%; p=0.0009), however most patients (83%) who have not had their primary removed do not ultimately have a stoma. The alternative to stoma formation or resection is stenting which is used at the time of impending or complete obstruction. This relatively new technology did not appear to be used in high proportions (8%) in this 2007-2008 cohort and the fact it was used more often in patients from areas with low deprivation (12% vs 4%), which may reflect an access or uptake issue. Analysis of the use of these interventions by chemotherapy use is required, however if the primary, instead of being managed operatively (resection or stoma formation), could be managed expectantly or with stent placement at obstruction, there is a large potential saving in terms of patient quality-of-life and resource utilisation.

The indications for the use of surgery to remove liver metastases are changing, with a lower threshold for operating on patients with more advanced disease, often in conjunction with ablative techniques such as radio-frequency ablation. In the PIPER cohort overall 7% of patients presenting with metastatic CRC had a liver resection (where 42% had liver disease) and whether this represents the current rate will need to be determined by further monitoring of this KPI. Although numbers are small further analysis is needed to explore the apparent difference by deprivation that may relate to comorbidity, ethnicity or rurality.

Palliative chemotherapy in the appropriately selected sub-population of metastatic CRC patients has, based on randomised trials, increased median survival from ~6 months to over 24 months with 5 year survival seen in 10-15% of patients. Key determinants of the selection of patients historically have been performance status, comorbidity, age and patient choice.

Although the PIPER study highlighted the poor documentation of performance status, further work looking at age and comorbidity, integrating ethnicity, rurality and NZDep should provide greater insights around decision-making with regard the decision to administer chemotherapy. As it stands however the fact that overall only 49% of stage IV patients with CRC received chemotherapy is of concern.

In keeping with the overall PIPER cohort the documented use of an MDM to discuss treatment decisions is low in those with metastatic disease. 16% were discussed prior to first treatment. Whilst for some who were not discussed prior to first treatment, this may be due to the need for urgent surgery, there is still a high proportion whom may benefit from discussion of the different first treatment modalities. This may also be linked to the low uptake of palliative chemotherapy in this group.

Highlights: Metastatic CRC

52% of patients with metastatic disease had their primary resected

83% of those without primary tumour resection did not have a stoma.

Overall 7% of patients had liver resection and 1% of patients had lung resection for metastatic disease

Overall only 49% of patients with metastatic colorectal cancer received chemotherapy

Rural patients were more likely to receive chemotherapy than urban patients (unadjusted finding)

Overall for 59% of patients there was no evidence of discussion at an MDM

5 Concluding Statements and Future Recommendations

Outcomes from the PIPER Project – what have we learned?

The PIPER project provides the most comprehensive description of the presentation, diagnosis, and management of CRC that has ever been undertaken in NZ. One of the major strengths of the project has been the inclusion of data from the private sector, as well as the public sector, to ensure a genuine national overview.

The PIPER cohort was taken from 2007-2008, to enable a period of follow up and so that mature survival data are available for examining the influence of the key indicators described on disease outcomes.

During the intervening time, the major change in systemic therapy was the introduction of adjuvant oxaliplatin. Other changes in treatment included the broader utilization of PET, wider uptake of Enhanced Recovery After Surgery (ERAS) protocols, and the beginning of the Waitemata Bowel Screening pilot. While considerable policy changes have occurred since, the medical and surgical management of colon and rectal cancer has evolved slightly rather than radically.

Several key facts about CRC in NZ have been established and are covered in detail within the body of the report. These key facts include:

Tumour staging and patient characteristics:

- 12% of colon cancer was stage I, 27% stage II, 25% stage III, 23% stage IV, 5% non-metastatic not further classified, and 7% unknown;
- 76% of rectal cancer was non-metastatic, 19% metastatic and 5% unknown.
- 24% of patients are 80 or older;
- Māori and Pacific have higher proportions who present with metastatic disease;
- Despite hand-searching original clinical records we were unable to identify staging for some patients. This has important implications for understanding stage-specific survival, and comparing stage-specific outcomes against international data sets.

Presentation and clinical staging procedures:

- Emergency presentation with colon cancer was common, more so for Māori (44%) and Pacific (51%), but overall was much higher than comparable results from the UK, where the corresponding proportion is 21%;
- The proportion of patients with colon cancer presenting with obstruction was 22%;
- Minimum staging with CT abdomen/pelvis and complete colonoscopy with a year was incomplete in almost half of the patients.

Multidisciplinary team discussion:

- MDM discussion was not documented for 70% of patients with colon cancer, and was not documented prior to first treatment in rectal cancer for 65% of patients. In the UK, MDM discussion is mandatory, and the "not discussed" target is 0%.

Surgical outcomes

- 90 day post-operative mortality for rectal cancer was 3% and for colon cancer was 5%;
- Major post-operative complications such as PE and MI are recorded in fewer cases than in published literature. This suggests we may be under-capturing peri-operative morbidity;
- Anastomotic leak rates are challenging to capture using existing methods. To allow routine monitoring of this, changes to current methods of reporting will need to be made.

Pathology reporting:

- Synoptic (structured) reporting was evident for 56% of colon cancer patients and for 51% of rectal cancer patients;
- Mesorectal quality was unknown in 65% of rectal cancer specimens, and distance to mesorectal fascia (circumferential resection margin) was unknown in 37%;
- 34% of patients have fewer than 12 nodes examined, according to their pathology report.

Chemotherapy for stage 3 colon cancer:

- 59% of patients with stage 3 colon cancer receive adjuvant chemotherapy (26% of those with colon cancer are 80 or older);
- Less than half of the treated patients complete 24 weeks of full therapy.

Therapy for metastatic CRC:

- 49% of patients receive chemotherapy;
- 51% of those who present with metastatic disease and synchronous primary tumours (true stage IV disease) have primary tumour resection;
- 7% of those with metastatic disease (synchronous presentation) undergo liver or lung resection.

As expected with an ambitious project with a large dataset, many additional analyses are possible, and indeed many are planned. The impact of demographic, clinical and disease characteristics need to be taken into account, and the complex interplay between rurality, ethnicity, and deprivation needs to be explored, in order to identify inequities of treatment or outcome in more detail.

There are some areas that already stand out for comment:

1. High rates of emergency presentation

Why do so many people present to the emergency department with colon cancer? Why is it worse for Māori and Pacific? Are there barriers to patients accessing general practice (such as financial or structural), and is this worse for certain groups within our community? Do general practitioners have sufficient access to the necessary tools to investigate patients with symptoms? Do we need better tests to discern benign abdominal symptoms from ones which are more sinister? Is there sufficient awareness of the importance of bowel symptoms within the community?

2. The interaction between comorbidity, treatment and outcome requires careful consideration

Comorbidity appears to influence the proportion of patients receiving intervention. A wealth of domestic and international literature shows that comorbidity mediates treatment received, and that this negatively impacts on cancer-specific and patient-related outcome. How can we restructure our services in order to better address this major area of need? A rigorous health care implementation study, preferably randomized, could examine novel methods of service delivery in order to ensure that service intervention is evidence based and cost effective, and delivers meaningful health gains.

3. Genomic correlation with clinical outcome data may yield valuable additional information

We have a preponderance of right sided tumours, particularly in females. This is higher than in many other countries. Recent evidence suggests that right sided tumours may be biologically different to left sided tumours. We will analyse our data set according to right or left side, particularly for chemotherapy use, response and outcome. The integration of genomics and prognostic signatures (including immune scores) is likely to gain traction in clinical practice in the foreseeable future, and our dataset, if combined with archival tumour samples, could provide a very rich data source.

4. Improvements in pathology reporting are necessary

Our pathology reporting may need further attention, although it should be noted the Royal College of Pathologists of Australasia has undertaken significant work on developing structured and synoptic reporting since 2009. Until these structured reports are mandated and standardised the potential for lower quality information will persist. The pathology report remains a significant opportunity for routine data capture which is rich and meaningful. Standard 8 in the Standards of Service Provision for CRC stated that pathology reports be reported in synoptic format. There was not additional granularity about the content (such as number of lymph nodes retrieved, R status, distance to circumferential margin in rectal cancer) of synoptic reports.

Until we have more comprehensive coverage of synoptic reporting, many of our attempts to improve quality outcomes particularly in rectal cancer will be stymied.

5. MDM discussion was low for this cohort

Our rates of documentation of MDM discussion were very low. Multidisciplinary collaboration is increasingly important with greater sub-specialisation, and the broader range of therapeutic options that may improve survival for the modern patient. Concern persists within the Cancer Sector regarding regional variation in MDM functionality and capacity. The MDM has also been mooted by some as a potential mechanism of data collection – until we can be assured of greater coverage than we have seen in this report, then the MDM may not be an appropriate vehicle to capture data from the broader population.

6. Chemotherapy intervention rates for stage IV disease appear lower than expected

We treat less than half of our patients who have metastatic disease with chemotherapy, yet we operate on more than half. Resection of the primary tumour has not been clearly shown to improve survival, whereas chemotherapy can improve survival three-fold or more. Surgery is frequently undertaken for palliative reasons including obstruction, and few would question this approach. However given that deferred primary tumour resection is viable for many non-obstructed patients, we should not resile from discussing whether we have the emphasis and balance in managing stage IV CRC completely right.

7. Surgical intervention with curative intent for stage IV disease

7% of patients undergo secondary resection of metastatic disease. We do not yet know whether there is regional variation in this, or whether increasing multi-disciplinary collaboration improves access to secondary resection. Giving this area further attention would enable greater understanding of how best to serve those patients with potentially curable stage IV disease, and how to increase the proportion of patients considered for curative therapy.

8. A high proportion of patients are elderly, and the optimal treatment paradigm for this group is unclear

It remains unclear how we should treat our elderly patients (aged over 80) with CRC, who make up approximately ¼ of those newly diagnosed. Our intervention rates with chemotherapy in this cohort are lower than for other age groups, yet for many in this group colorectal cancer remains the life-limiting comorbidity. This raises challenging questions about patient selection, understanding patient choice, the interplay between age, comorbidity and treatment, and understanding any potential health-services factors that may contribute to patterns of care.

Some of these facts are confronting. Many are comforting. It may be tempting to dismiss the ones we don't like as "old" data that we have moved beyond by improvements in systems or services.

However we now have measured the baseline, and any attempts to dismiss or refute these findings as irrelevant should be accompanied by robust data, and importantly include careful consideration of appropriate denominators for key performance measures.

What changes have there been since the PIPER cohort?

The changes in clinical management of CRC since 2007 have been incremental and minor, and whist we would expect there to have been improvements in care, these have been minor shifts rather than tectonic ones.

The policy environment around bowel cancer has however changed meaningfully.

Since 2007, some of the policy and structural changes include:

- Faster cancer treatment initiative – this government initiative requires that patients diagnosed with cancer receive first treatment within 31 days of decision to treat (not date of diagnosis), and those with a high suspicion of cancer receive treatment within 62 days of first referral.
- Standards of Service Provision for CRC have been produced.
- There has been an increase in the number and effectiveness of MDMs around the country, with progress on electronic recording of data in several regions.
- The National Bowel Cancer Work Group has been formed and is active on a national work plan
- The Waitemata Bowel Cancer Screening Pilot has progressed – this is particularly important with fewer than 12% of tumours being diagnosed at stage 1 in NZ
- Direct access colonoscopy criteria have been formed and implemented, with criteria for 2 and 6 week access, with proportions meeting these criteria now reported to the Ministry of Health
- Patient and Consumer groups such as the Gastrointestinal Cancer Institute of NZ (GICI) and Bowel Cancer NZ (formerly known as Beat Bowel Cancer Aotearoa) have become increasingly active, and demand a high level of transparency in the national debate about cancer service provision and direction
- Enhanced recovery after surgery (ERAS) services have grown with shorter length of stay and lower post-op morbidity
- There has been outsourcing of many pathology laboratories to private providers, which has attracted considerable media attention and professional debate. We did not examine whether there was a relationship between public or private service providers and the level of detail contained within pathology reports. A minimum pathology dataset can be required of any publically funded laboratory, and therefore outsourcing is not a barrier to comprehensive synoptic reporting.

The data contained in this report demonstrate that doing things faster is only one part of the outcome puzzle, and that there remains room for emphasis on "Better" in the health policy framework of "Better, Sooner, More Convenient Cancer Care".

National tumour standards will provide this focus, but ongoing monitoring and reporting of outcomes in this framework is essential, and is currently missing.

At present we have concentrated many of our policy outcome measures on who we are treating. The results from PIPER also challenge us to consider whom we are missing.

Where has PIPER taken us, and where to from here?

The PIPER project is the culmination of 4 years of work beginning with a tender process from the Ministry of Health and HRC aiming to understand the breadth and depth of the pathway of presentation, diagnosis and management of CRC in NZ.

The research team we constructed aimed to bring together individuals with diverse expertise across a range of areas with an interest in CRC. These experts came from population health, general practice, rural health, medical and radiation oncology, general and specialist surgery, patient representative groups, Māori and Pacific health experts, health management, as well as academic biostatisticians and health research staff.

Following consultation with investigators and advisors, with careful review of relevant domestic and international guidelines, as well as cross referencing the Colorectal Surgical Society of Australia and NZ (CSSANZ) database and other international colorectal databases, we piloted an ambitious list of quality indicators and time points on a patient journey that could be related to quality of experience, quality of care, and overall outcome. We tested our list of key indicators on many members of the NZ colorectal community and listened to feedback, improved and refined.

We piloted this list with 226 cases and found that there were too many data-points to collect within the constraints of time and funding that we had available. Additionally, there were several data items that were very poorly recorded in patient notes or other source documents, which were contradictory within the notes, or were too open to subjective interpretation to be useful.

Some of these variables included: distance of rectal tumour from the anal verge; pre-operative tumour stage in rectal cancer; distance to circumferential resection margin in rectal cancer (pre-operative); family history; smoking status; duration of chemotherapy; chemotherapy dose reductions or treatment delays; whether patients were offered a clinical trial; and ECOG performance status. Frequently, treatment intent (palliative or curative) was vague or unstated. Our clinical detection rates of post-operative pulmonary embolus are considerably lower than published comparators, potentially highlighting poor capture of meaningful complications.

We hand searched the records of 6387 patients in both public and private settings, investing in over 9,000 hours of clinical notes review. Over 960,000 individual data points were entered onto an original database housed at CTNZ. Thousands of comparisons and analyses were and are possible with this cleaned and high-grade clinical data set.

The PIPER project is a landmark in CRC research in NZ.

However, we do not want to have to do it again.

The process of manual data collection is time consuming, but is useful to provide a national stock take and identify areas for immediate policy focus, and validates or repudiates the routine data sources and informs our ability to rely on them for monitoring purposes.

PIPER has given us considerable insight into data quality of routine datasets, and planned publications include a comparison of our hand-searched data with that held by the cancer registry, and data from other centrally held routine datasets. We have formed relationships with other international CRC registry projects which will enable future collaboration and comparison of outcome measures.

Our project has highlighted some major constraints to ongoing monitoring of cancer outcomes. Even the most (apparently) simple but fundamental data point – cancer stage – is dynamic over the pre-operative, operative and early post-operative stage, and requires that strong, clear and reliable business rules be written around data required for defining stage and how that is recorded and reported.

Our data recording on a day-to-day basis in clinical practice needs to improve if we are to examine quality in a more real-time and meaningful way. If we can achieve this, we can detect systems issues and drive quality improvements for the people of NZ, whom we are employed to serve. Manual data entry is unappealing for the overloaded clinician, but perhaps nationally standardized collection methods, for example through a mandated surgical database, or through cancer multi-disciplinary meetings (with joined up IT infrastructure) could be feasible.

CRC is a leading source of morbidity and mortality in NZ. It is our most common cancer and our rates are amongst the highest in the world. Our outcomes are worse than Australia, with death rates 35 percent higher than in Australia for women and 24 percent higher for men.

Our collective challenge is to design and implement changes in our health system that transforms us from being a country with a high mortality rate from CRC to one that leads the world in colorectal cancer survival.

6 References

1. Ministry of Health, New Zealand. Cancer: New Registrations and Deaths 2011. Wellington, New Zealand: Ministry of Health, New Zealand; 2014.

2. Robson B, Cormack D. Unequal Impact II: Maori and non-Maori Cancer Statistics by Deprivation and Rural-Urban Status 2002-2006. Wellington, New Zealand: Ministry of Health; 2010.

3. Hill S, Sarfati D, Blakely T, Robson B, Purdie G, Dennett E, et al. Ethnicity and management of colon cancer in New Zealand: do indigenous patients get a worse deal?. *Cancer* 2010; Jul 1;116(13):3205-14.

4. Shah AB, Sarfati D, Blakely T, Atkinson J, Dennett ER. Trends in colorectal cancer incidence rates in New Zealand, 1981-2004. *ANZ Journal of Surgery* 2012; Apr;82(4):258-64.

5. Tumor Location in Colorectal Cancer May Influence Survival. *Journal of the National Cancer Institute* 2015; March 01;107(3).

6. Bayley A, Goodyear R. New Zealand: An Urban/Rural Profile . Wellington, New Zealand: The Product Development and Publishing Services Division of Statistics New Zealand.; 2004.

7. Health and Social Care Information Centre. *National Bowel Cancer Audit Annual Report 2013.* UK: Health and Social Care Information Centre; 2013.

8. Maringe C, Walters S, Rachet B, Butler J, Fields T, Finan P, et al. Stage at diagnosis and colorectal cancer survival in six high-income countries: A population-based study of patients diagnosed during 2000–2007. *Acta Oncol* 2013; 06/01; 2015/03;52(5):919-32.

9. McClements PL, Madurasinghe V, Thomson CS, Fraser CG, Carey FA, Steele RJ, et al. Impact of the UK colorectal cancer screening pilot studies on incidence, stage distribution and mortality trends. *Cancer Epidemiology* 2012;36(4):e232-42.

10. Heriot A, Hunter A, Platell C, Byrne C, Chapuis P, Doudle M, et al. The Bi-National Colorectal Cancer Audit Report 2015. Victoria, Australia: The Bi-National Colorectal Cancer Audit; May 2015.

11. Finan P, Smith J, Morris E, Greenaway K. National Bowel Cancer Audit - 2009. United Kingdom: Health and Social Care Information Centre; October 2009.

12. Siegel R, Desantis C, Jemal A. Colorectal cancer statistics, 2014. *CA Cancer J Clin* 2014; Mar-Apr;64(2):104-17.

13. GLOBOCAN 2012 v1.0, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 11 [Internet]. Available at: Available from: http://globocan.iarc.fr, accessed on 24th February 2015.

14. Alafeishat L, Elwood M, Ioannides S. Cancer mortality and incidence trends comparing New Zealand and Australia for the period 2000-2007. *The New Zealand Medical Journal* 2014; Aug 15;127(1400):9-19.

15. Kanavos P, Schurer W. The dynamics of colorectal cancer management in 17 countries. *Eur J Health Econ* 2010; Jan;10(Suppl 1):S115-29.

16. Keating J, Yong D, Cutler G, Johnston J. Multidisciplinary treatment of colorectal cancer in New Zealand: survival rates from 1997-2002. *N Z Med J* 2006;119(1242):U2238.

17. Robson B, Purdie G, Cormack D. Unequal impact: Maori and non-Maori cancer statistics 1996-2001. Wellington, New Zealand: Ministry of Health; 2006.

18. Hill S, Sarfati D, Blakely T, Robson B, Purdie G, Dennett E, et al. Ethnicity and management of colon cancer in New Zealand: do indigenous patients get a worse deal?. *Cancer* 2010; Jul 1;116(13):3205-14.

19. Swart EM, Sarfati D, Cunningham R, Dennett E, Signal V, Gurney J, et al. Ethnicity and rectal cancer management in New Zealand. *N Z Med J* 2013; Oct 18;126(1384):42-52.

20. Statistics New Zealand. 2013 Census QuickStats about culture and identity. Wellington, New Zealand: Statistics New Zealand; 2014.

21. Meredith I, Sarfati D, Ikeda T, Blakely T. Cancer in Pacific people in New Zealand. *Cancer Causes & Control : CCC* 2012; Jul;23(7):1173-84.

22. Ministry of Health. *Cancer: New Registrations and Deaths 2010.* Wellington, New Zealand: Ministry of Health; 2013.

23. Ministry of Health. *Cancer: New Registrations and Deaths 2009.* Wellington, New Zealand: Ministry of Health; 2012.

24. Hsiang JC, Bai W, Lal D. Symptom presentations and other characteristics of colorectal cancer patients and the diagnostic performance of the Auckland Regional Grading Criteria for Suspected Colorectal Cancer in the South Auckland population. *N Z Med J* 2013; Sep 13;126(1382):95-107.

25. Goggins WB, Wong GK. Poor survival for US Pacific Islander cancer patients: evidence from the Surveillance, Epidemiology, and End Results database: 1991 to 2004. *J Clin Oncol* 2007; Dec 20;25(36):5738-41.

26. Olver I, Marine F, Grogan P. Disparities in Cancer Care in Australia and the Pacific. *The Oncologist* 2011; July 01;16(7):930-4.

27. Tukuitonga C. Pacific Island health - Causes of poor health. Te Ara - the Encyclopedia of New Zealand. Available at: http://www.teara.govt.nz/en/pacific-island-health/page-5. Accessed 13th March 2015

28. Jeffreys M, Sarfati D, Stevanovic V, Tobias M, Lewis C, Pearce N, et al. Socioeconomic inequalities in cancer survival in New Zealand: the role of extent of disease at diagnosis. *Cancer Epidemiol Biomarkers Prev* 2009; Mar;18(3):915-21.

29. Edge SB, Compton CC. The American Joint Committee on Cancer: the 7th edition of the AJCC cancer staging manual and the future of TNM. *Ann Surg Oncol* 2010; Jun;17(6):1471-4.

30. Beatty S, Stevens W, Stevens G, Kolbe J, Cox B. Lung cancer patients in New Zealand initially present to secondary care through the emergency department rather than by referral to a respiratory specialist. *NZ Med J* 2009;122(1294):33-41.

31. Ratto C, Sofo L, Ippoliti M, Merico M, Doglietto GB, Crucitti F. Prognostic factors in colorectal cancer. Literature review for clinical application. *Diseases of the Colon and Rectum* 1998; Aug;41(8):1033-49.

32. Gatsoulis N, Roukounakis N, Kafetzis I, Mavrakis G. Surgical management of large bowel obstruction due to colonic cancer. *Techniques in Coloproctology* 2004;8(1):s82-4.

33. Quereshy FA, Poon JT, Law WL. Long-term outcome of stenting as a bridge to surgery for acute left-sided malignant colonic obstruction. *Colorectal Disease : The Official Journal of the Association of Coloproctology of Great Britain and Ireland* 2014; Oct;16(10):788-93.

34. Shah AB, Sarfati D, Blakely T, Atkinson J, Dennett ER. Trends in colorectal cancer incidence rates in New Zealand, 1981-2004. *ANZ Journal of Surgery* 2012; Apr;82(4):258-64.

35. Wrigley H, Roderick P, George S, Smith J, Mullee M, Goddard J. Inequalities in survival from colorectal cancer: a comparison of the impact of deprivation, treatment, and host factors on

observed and cause specific survival. *Journal of Epidemiology and Community Health* 2003; April 01;57(4):301-9.

36. New Zealand Guidelines Group. Clinical practice guidelines for the management of early colorectal cancer. Wellington: New Zealand Guidelines Group; 2011.

37. Hogan JMB, O'Rourke CMB, M.Ch., Duff GMB, Burton MMB, Kelly NMB, et al. Preoperative Staging CT Thorax in Patients With Colorectal Cancer: Its Clinical Importance. *Diseases of the Colon & Rectum* 2014; November;57(11):1260-6.

38. Parnaby CN, Bailey W, Balasingam A, Beckert L, Eglinton T, Fife J, et al. Pulmonary staging in colorectal cancer: a review. *Colorectal Disease* 2012;14(6):660-70.

39. Messenger DE, McLeod RS, Kirsch R. What Impact Has the Introduction of a Synoptic Report for Rectal Cancer Had on Reporting Outcomes for Specialist Gastrointestinal and Nongastrointestinal Pathologists?. *Arch Pathol Lab Med* 2011; 11/01; 2015/03;135(11):1471-5.

40. Launch of structured reporting ensures patients receive world's best practice in cancer care. Available at: http://www.rcpa.edu.au/getattachment/c5e2e034-cdeb-4d64-a9cd-052c0dac67a0/(4).aspx.

41. Baxter NN, Virnig DJ, Rothenberger DA, Morris AM, Jessurun J, Virnig BA. Lymph node evaluation in colorectal cancer patients: a population-based study. *J Natl Cancer Inst* 2005; Feb 2;97(3):219-25.

42. Byrne BE, Mamidanna R, Vincent CA, Faiz O. Population-based cohort study comparing 30- and 90-day institutional mortality rates after colorectal surgery. *Br J Surg* 2013;100(13):1810-7.

43. Compton CC, Greene FL. The Staging of Colorectal Cancer: 2004 and Beyond. *CA: A Cancer Journal for Clinicians* 2004;54(6):295-308.

44. Andreoni B, Chiappa A, Bertani E, Bellomi M, Orecchia R, Zampino M, et al. Surgical outcomes for colon and rectal cancer over a decade: results from a consecutive monocentric experience in 902 unselected patients. *World J Surg Oncol* 2007;5(73):73.

45. FOxTROT Collaborative Group. Feasibility of preoperative chemotherapy for locally advanced, operable colon cancer: the pilot phase of a randomised controlled trial. *The Lancet Oncology* 2012;13(11):1152-60.

46. Colon Cancer Laparoscopic or Open Resection Study Group. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. *The Lancet Oncology* 2005;6(7):477-84.

47. Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. *N Engl J Med* 2004; May 13;350(20):2050-9.

48. Spanjersberg WR, Reurings J, Keus F, van Laarhoven CJ. Fast track surgery versus conventional recovery strategies for colorectal surgery. *The Cochrane Library* 2011.

49. Lemanu D, Singh P, Stowers M, Hill A. A systematic review to assess cost effectiveness of enhanced recovery after surgery programmes in colorectal surgery. *Colorectal Disease* 2014;16(5):338-46.

50. van Westreenen HL, Ijpma FF, Wevers KP, Afzali H, Patijn GA. Reoperation after colorectal surgery is an independent predictor of the 1-year mortality rate. *Dis Colon Rectum* 2011; Nov;54(11):1438-42.

51. Burns EM, Bottle A, Aylin P, Darzi A, Nicholls RJ, Faiz O. Variation in reoperation after colorectal surgery in England as an indicator of surgical performance: retrospective analysis of Hospital Episode Statistics. *BMJ* 2011; Aug 16;343:d4836.

52. Daams F, Wu Z, Lahaye MJ, Jeekel J, Lange JF. Prediction and diagnosis of colorectal anastomotic leakage: A systematic review of literature. *World Journal of Gastrointestinal Surgery* 2014;6(2):14.

53. Rahbari NN, Weitz J, Hohenberger W, Heald RJ, Moran B, Ulrich A, et al. Definition and grading of anastomotic leakage following anterior resection of the rectum: a proposal by the International Study Group of Rectal Cancer. *Surgery* 2010;147(3):339-51.

54. Dik V, Aarts M, Van Grevenstein W, Koopman M, Van Oijen M, Lemmens V, et al. Association between socioeconomic status, surgical treatment and mortality in patients with colorectal cancer. *Br J Surg* 2014;101(9):1173-82.

55. Moghadamyeghaneh Z, Hanna MH, Carmichael JC, Nguyen NT, Stamos MJ. A Nationwide Analysis of Postoperative Deep Vein Thrombosis and Pulmonary Embolism in Colon and Rectal Surgery. *Journal of Gastrointestinal Surgery* 2014;18(12):2169-77.

56. Vedovati MC, Becattini C, Rondelli F, Boncompagni M, Camporese G, Balzarotti R, et al. A randomized study on 1-week versus 4-week prophylaxis for venous thromboembolism after laparoscopic surgery for colorectal cancer. *Ann Surg* 2014; Apr;259(4):665-9.

57. NIH Consensus Conference. Adjuvant therapy for patients with colon and rectal cancer. *JAMA* 1990; September 19;264(11):1444-50.

58. Wolmark N, Rockette H, Mamounas E, Jones J, Wieand S, Wickerham DL, et al. Clinical trial to assess the relative efficacy of fluorouracil and leucovorin, fluorouracil and levamisole, and fluorouracil, leucovorin, and levamisole in patients with Dukes' B and C carcinoma of the colon: results from National Surgical Adjuvant Breast and Bowel Project C-04. *J Clin Oncol* 1999; Nov;17(11):3553-9.

59. Haller DG, Catalano PJ, Macdonald JS, O'Rourke MA, Frontiera MS, Jackson DV, et al. Phase III study of fluorouracil, leucovorin, and levamisole in high-risk stage II and III colon cancer: final report of Intergroup 0089. *J Clin Oncol* 2005; Dec 1;23(34):8671-8.

60. Kuebler JP, Wieand HS, O'Connell MJ, Smith RE, Colangelo LH, Yothers G, et al. Oxaliplatin combined with weekly bolus fluorouracil and leucovorin as surgical adjuvant chemotherapy for stage II and III colon cancer: results from NSABP C-07. *J Clin Oncol* 2007; Jun 1;25(16):2198-204.

61. Jessup JM, Stewart A, Greene FL, Minsky BD. Adjuvant chemotherapy for stage III colon cancer: implications of race/ethnicity, age, and differentiation. *JAMA* 2005;294(21):2703-11.

62. Heong V, Wong H, Tie J, Jefford M, Field KM, Kosmider S, et al. Understanding why some people with stage III colon cancer do not receive adjuvant chemotherapy. *Journal of Clinical Oncology* 2013;31(suppl):abstr e14608.

63. Harris AR, Bowley DM, Stannard A, Kurrimboccus S, Geh JI, Karandikar S. Socioeconomic deprivation adversely affects survival of patients with rectal cancer. *Br J Surg* 2009;96(7):763-8.

64. Tilney HMRCS, Lovegrove REMRCS, Smith JJMD, F.R.C.S., Thompson MRMD, F.R.C.S., et al. The National Bowel Cancer Project: Social Deprivation Is an Independent Predictor of Nonrestorative Rectal Cancer Surgery. *Diseases of the Colon & Rectum* 2009; June;52(6):1046-53.

65. Glimelius B, Tiret E, Cervantes A, Arnold D, on behalf of the ESMO Guidelines Working Group. Rectal cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Annals of Oncology* 2013; October 01;24(suppl 6):vi81-8.

66. Miller EDPD, Robb BWMD, Cummings OWMD, Johnstone PASMD. The Effects of Preoperative Chemoradiotherapy on Lymph Node Sampling in Rectal Cancer. *Diseases of the Colon & Rectum* 2012; September;55(9):1002-7.

67. Morcos B, Baker B, Al Masri M, Haddad H, Hashem S. Lymph node yield in rectal cancer surgery: Effect of preoperative chemoradiotherapy. *European Journal of Surgical Oncology (EJSO)* 2010; 4;36(4):345-9.

68. Nagtegaal ID, van de Velde CJH, van der Worp E, Kapiteijn E, Quirke P, van Krieken JHJM, et al. Macroscopic Evaluation of Rectal Cancer Resection Specimen: Clinical Significance of the Pathologist in Quality Control. *Journal of Clinical Oncology* 2002; April 01;20(7):1729-34.

69. O'Grady G, Secker A. Colorectal cancer management in the provincial New Zealand setting of Nelson. *ANZ J Surg* 2007;77(11):1004-8.

70. Morris AM, Baldwin L, Matthews B, Dominitz JAMHS, Barlow WE, Dobie SAMCP, et al. Reoperation as a Quality Indicator in Colorectal Surgery: A Population-Based Analysis. *Ann Surg* 2007; January;245(1):73-9.

71. Mayo SC, Shore AD, Nathan H, Edil BH, Hirose K, Anders RA, et al. Refining the definition of perioperative mortality following hepatectomy using death within 90 days as the standard criterion. *HPB* 2011;13(7):473-82.

72. Gooiker GA, Dekker JWT, Bastiaannet E, van der Geest, Lydia GM, Merkus JW, van de Velde, Cornelis JH, et al. Risk factors for excess mortality in the first year after curative surgery for colorectal cancer. *Annals of Surgical Oncology* 2012;19(8):2428-34.

73. Mirnezami AFRCS, Mirnezami RMRCS, Chandrakumaran KFRCS, Sasapu KFRCS, Sagar PFRCS, Finan PFRCS. Increased Local Recurrence and Reduced Survival From Colorectal Cancer Following Anastomotic Leak: Systematic Review and Meta-Analysis. *Ann Surg* 2011; May;253(5):890-9.

74. Archampong D, Borowski D, Wille-Jørgensen P, Iversen LH. Workload and surgeon's specialty for outcome after colorectal cancer surgery [dissertation]. Wiley Online Library; 2012.

75. Tortorelli AP, Alfieri S, Sanchez AM, Rosa F, Papa V, Di Miceli D, et al. Anastomotic Leakage after Anterior Resection for Rectal Cancer with Mesorectal Excision: Incidence, Risk Factors, and Management. *Am Surg* 2015;81(1):41-7.

76. Reinke CEMD, M.S.P.H., Showalter SMD, Mahmoud NNMD, Kelz RRMD, M.S.C.E. Comparison of Anastomotic Leak Rate After Colorectal Surgery Using Different Databases. *Diseases of the Colon & Rectum* 2013; May;56(5):638-44.

77. MacFarlane JK, Ryall RDH, Heald RJ. Mesorectal excision for rectal cancer. *The Lancet* 1993; 2/20;341(8843):457-60.

78. Bosset J, Collette L, Calais G, Mineur L, Maingon P, Radosevic-Jelic L, et al. Chemotherapy with Preoperative Radiotherapy in Rectal Cancer. *N Engl J Med* 2006; 09/14; 2015/03;355(11):1114-23.

79. Peeters KC, van de Velde CJ, Leer JW, Martijn H, Junggeburt JM, Kranenbarg EK, et al. Late side effects of short-course preoperative radiotherapy combined with total mesorectal excision for rectal cancer: increased bowel dysfunction in irradiated patients--a Dutch colorectal cancer group study. *J Clin Oncol* 2005; Sep 1;23(25):6199-206.

80. Peeters KCMJ, Marijnen CAM, Nagtegaal ID, Kranenbarg EK, Putter H, Wiggers T, et al. The TME Trial After a Median Follow-up of 6 Years: Increased Local Control But No Survival Benefit in Irradiated Patients With Resectable Rectal Carcinoma. *Ann Surg* 2007; November;246(5):693-701.

81. Sebag-Montefiore D, Stephens RJ, Steele R, Monson J, Grieve R, Khanna S, et al. Preoperative radiotherapy versus selective postoperative chemoradiotherapy in patients with rectal cancer (MRC CR07 and NCIC-CTG C016): a multicentre, randomised trial. *The Lancet* 2009;373(9666):811-20.

82. Birgisson H, Påhlman L, Gunnarsson U, Glimelius B. Adverse Effects of Preoperative Radiation Therapy for Rectal Cancer: Long-Term Follow-Up of the Swedish Rectal Cancer Trial. *Journal of Clinical Oncology* 2005; December 01;23(34):8697-705.

83. Bujko K, Nowacki MP, Nasierowska-Guttmejer A, Michalski W, Bebenek M, Kryj M. Long-term results of a randomized trial comparing preoperative short-course radiotherapy with preoperative conventionally fractionated chemoradiation for rectal cancer. *Br J Surg* 2006;93(10):1215-23.

84. Ngan SY, Burmeister B, Fisher RJ, Solomon M, Goldstein D, Joseph D, et al. Randomized Trial of Short-Course Radiotherapy Versus Long-Course Chemoradiation Comparing Rates of Local Recurrence in Patients With T3 Rectal Cancer: Trans-Tasman Radiation Oncology Group Trial 01.04. *Journal of Clinical Oncology* 2012; November 01;30(31):3827-33.

85. Breugom AJ, Swets M, Bosset J, Collette L, Sainato A, Cionini L, et al. Adjuvant chemotherapy after preoperative (chemo) radiotherapy and surgery for patients with rectal cancer: a systematic review and meta-analysis of individual patient data. *The Lancet Oncology* 2015;.

86. Hong YS, Nam B, Kim K, Kim JE, Park SJ, Park YS, et al. Oxaliplatin, fluorouracil, and leucovorin versus fluorouracil and leucovorin as adjuvant chemotherapy for locally advanced rectal cancer after preoperative chemoradiotherapy (ADORE): an open-label, multicentre, phase 2, randomised controlled trial. *The Lancet Oncology* 2014;15(11):1245-53.

87. Health and Social Care Information Centre. *National Bowel Centre Audit Progress Report 2014 - Tripartite Colorectal Meeting.* UK: Health and Social Care Information Centre; 2014.

88. Stillwell AP, Buettner PG, Ho YH. Meta-analysis of survival of patients with stage IV colorectal cancer managed with surgical resection versus chemotherapy alone. *World J Surg* 2010; Apr;34(4):797-807.

89. Cirocchi R, Trastulli S, Abraha I, Vettoretto N, Boselli C, Montedori A, et al. Non-resection versus resection for an asymptomatic primary tumour in patients with unresectable stage IV colorectal cancer. *The Cochrane Database of Systematic Reviews* 2012;8:CD008997.

90. Rahbari NN, Lordick F, Fink C, Bork U, Stange A, Jager D, et al. Resection of the primary tumour versus no resection prior to systemic therapy in patients with colon cancer and synchronous unresectable metastases (UICC stage IV): SYNCHRONOUS--a randomised controlled multicentre trial (ISRCTN30964555). *BMC Cancer* 2012;12:142.

91. Cunningham D, Pyrhonen S, James RD, Punt CJ, Hickish TF, Heikkila R, et al. Randomised trial of irinotecan plus supportive care versus supportive care alone after fluorouracil failure for patients with metastatic colorectal cancer. *Lancet* 1998; Oct 31;352(9138):1413-8.

92. Scheithauer W, Rosen H, Kornek GV, Sebesta C, Depisch D. Randomised comparison of combination chemotherapy plus supportive care with supportive care alone in patients with metastatic colorectal cancer. *BMJ* 1993; Mar 20;306(6880):752-5.

93. de Gramont A, Figer A, Seymour M, Homerin M, Hmissi A, Cassidy J, et al. Leucovorin and fluorouracil with or without oxaliplatin as first-line treatment in advanced colorectal cancer. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology* 2000; Aug;18(16):2938-47.

94. Tournigand C, Andre T, Achille E, Lledo G, Flesh M, Mery-Mignard D, et al. FOLFIRI followed by FOLFOX6 or the reverse sequence in advanced colorectal cancer: a randomized GERCOR study. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology* 2004; Jan 15;22(2):229-37.

95. Koopman M, Antonini NF, Douma J, Wals J, Honkoop AH, Erdkamp FL, et al. Sequential versus combination chemotherapy with capecitabine, irinotecan, and oxaliplatin in advanced

colorectal cancer (CAIRO): a phase III randomised controlled trial. *Lancet* 2007; Jul 14;370(9582):135-42.

96. Seymour MT, Maughan TS, Ledermann JA, Topham C, James R, Gwyther SJ, et al. Different strategies of sequential and combination chemotherapy for patients with poor prognosis advanced colorectal cancer (MRC FOCUS): a randomised controlled trial. *Lancet* 2007; Jul 14;370(9582):143-52.

97. Grothey A, Sargent D, Goldberg RM, Schmoll H. Survival of Patients With Advanced Colorectal Cancer Improves With the Availability of Fluorouracil-Leucovorin, Irinotecan, and Oxaliplatin in the Course of Treatment. *Journal of Clinical Oncology* 2004; April 1, 2004;22(7):1209-14.

98. Adam R, Wicherts DA, de Haas RJ, Ciacio O, Levi F, Paule B, et al. Patients with initially unresectable colorectal liver metastases: is there a possibility of cure?. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology* 2009; Apr 10;27(11):1829-35.

99. Adam R, Avisar E, Ariche A, Giachetti S, Azoulay D, Castaing D, et al. Five-year survival following hepatic resection after neoadjuvant therapy for nonresectable colorectal. *Annals of Surgical Oncology* 2001; May;8(4):347-53.

100. Mitry E, Fields AL, Bleiberg H, Labianca R, Portier G, Tu D, et al. Adjuvant chemotherapy after potentially curative resection of metastases from colorectal cancer: a pooled analysis of two randomized trials. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology* 2008; Oct 20;26(30):4906-11.

101. Carpizo DR, Are C, Jarnagin W, Dematteo R, Fong Y, Gonen M, et al. Liver resection for metastatic colorectal cancer in patients with concurrent extrahepatic disease: results in 127 patients treated at a single center. *Annals of Surgical Oncology* 2009; Aug;16(8):2138-46.

102. Carpizo DR, D'Angelica M. Liver resection for metastatic colorectal cancer in the presence of extrahepatic disease. *The Lancet Oncology* 2009; Aug;10(8):801-9.

103. Nordlinger B, Sorbye H, Glimelius B, Poston GJ, Schlag PM, Rougier P, et al. Perioperative FOLFOX4 chemotherapy and surgery versus surgery alone for resectable liver metastases from colorectal cancer (EORTC 40983): long-term results of a randomised, controlled, phase 3 trial. *The Lancet Oncology* 2013; Nov;14(12):1208-15.

104. Gonzalez M, Poncet A, Combescure C, Robert J, Ris HB, Gervaz P. Risk factors for survival after lung metastasectomy in colorectal cancer patients: a systematic review and meta-analysis. *Annals of Surgical Oncology* 2013; Feb;20(2):572-9.