Prioritisation of lower gastrointestinal endoscopy during the COVID-19 pandemic: outcomes of a novel triage pathway

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ABSTRACT

Objective The 2-week-wait (2ww) referral pathway is used in England to fast-track patients with suspected colorectal cancer (CRC). A two-stage triage pathway was used to prioritise lower gastrointestinal (LGI) endoscopy for suspected CRC during the COVID-19 pandemic.

Method All patients referred for an LGI endoscopy via a 2ww referral pathway between March 2020 and July 2020 were assessed. The first stage triaged patients to high, standard or low risk of CRC based on symptoms and faecal immunochemical test (FIT), and offered CT scans to those at high risk. The second stage, endoscopy prioritisation (EP), incorporated the CT results, FIT and symptoms to triage into four groups, EP1–EP4; with EP1 being the most urgent and EP4 the least. The primary outcome measure was CRC detection.

Results 514 patients were included. The risk of CRC was triaged as high in 190/514 patients (37%), standard in 274/514 patients (53%) and low in 50/514 (10%) patients. 422/514 patients (82%) underwent endoscopy with triage to EP1 in 52/422 (12%), EP2 in 105/422 (25%), EP3 in 210/422 (50%) and EP4 in 55/422 (13%).

CRC was detected in 23 patients (5.4%). CRC was significantly more frequent in the EP1 group (23.1%, relative risk (RR)=16.2) and EP2 group (6.7%, RR=4.7) compared with EP3 group (1.4%). All CRC lesions were identified by CT imaging when performed prior to LGI endoscopy.

Conclusion This triage pathway designated 83% of patients with CRC to either EP1 or EP2. During a period of limited endoscopy provision, this pathway effectively prioritises endoscopy for those at greatest risk of CRC.

Key points

What is already known on this topic?

- The COVID-19 pandemic led to a significant reduction in the provision of endoscopy.
- The faecal immunochemical test (FIT) and symptoms predict risk of colorectal cancer (CRC), but prioritisation strategies for endoscopy have not been defined.

What this study adds?

- The majority of 2-week-wait referrals diagnosed with CRC have predictable high-risk features.
- A two-stage triage pathway, which used patient symptoms, FIT results and CT results, effectively prioritised patients for lower gastrointestinal endoscopy.

How might it impact on clinical practice in the foreseeable future?

- During periods of limited endoscopy provision, effective triage allows appropriate prioritisation of resources.
- This two-stage pathway both identified those at highest risk of CRC for further investigation with interim CT and prioritised the majority of CRC to undergo urgent endoscopic examination.

INTRODUCTION

The 2-week-wait (2ww) referral pathway is used in England to fast-track patients with suspected colorectal cancer (CRC). This pathway aims to improve early detection of CRC and increase survival, with lower gastrointestinal (LGI) endoscopy considered the gold standard diagnostic test. The COVID-19 pandemic significantly impacted the 2ww referral
pathway. At the start of the pandemic, national guidance advised pausing all but emergency endoscopic procedures.

Several predictors for CRC are recognised, including clinical symptoms, iron deficiency anaemia (IDA) and faecal immunochemical test (FIT) results. Studies report a higher risk of CRC when some symptoms present in combination rather than in isolation, in particular, rectal bleeding or IDA with other symptoms. These predictors of CRC were used in a two-stage triage pathway to expedite investigations in those at greatest CRC risk. The first stage used FIT results and symptoms to identify those at a higher risk of CRC, who were then considered for a CT scan. The second stage used these results to prioritise endoscopy urgency when services resumed.

METHODS

Patient cohort

The Sheffield Teaching Hospital’s (STH) two-stage pathway was prospectively applied to patients who were awaiting a 2ww LGI endoscopy at the time endoscopy services were paused in March 2020 and those referred until July 2020 when delays in endoscopy were reduced. Investigations performed up until November 2020 were included in the analysis.

The first stage of the pathway involved a case notes and laboratory data review by consultant gastroenterologists. Patients were categorised as having either a high, standard or low risk of CRC based on their FIT result and clinical symptoms. FIT results >60 μgHb/g were considered to indicate a high risk, 10–60 μgHb/g a standard risk and <10 μgHb/g a low risk of CRC. These thresholds were chosen based on FIT data describing the risk of CRC in patients with high-risk symptoms; these indicated that an FIT <10 μgHb/g had a <1% risk of CRC, an FIT 10–59 μgHb/g had a 2.6% risk of CRC, whereas a FIT 60–100 μgHb/g was associated with a 7.3% risk of CRC and patients with a FIT >100μgHb/g had a 20.7% risk of CRC. Referrers were asked to provide an FIT result for 2ww referrals, apart from those with rectal bleeding or a palpable mass, although it was not mandated. In patients without an FIT result, clinical symptoms were reviewed and categorised as high, standard or low risk for CRC (Table 1). Patients with symptoms that did not fulfil National Institute for Health and Clinical Excellence (NICE) Guideline NG12 criteria and those who had undergone a colonoscopy in the last 3 years, were categorised as low risk of CRC.

Case notes were also reviewed to identify risk factors for COVID-19 complications, including comorbidities and age, with a threshold of >70 years. Patients judged to be at high risk of CRC, without risk factors for COVID-19 complications, were offered a CT scan while awaiting resumption of endoscopy services. Patients were informed that CT was a more accessible intervention during the pandemic, but was not as accurate at diagnosing CRC as LGI endoscopy.

CT examination

Oral contrast was used to prepare patients for CT imaging. Five mL omnipaque 350 was dissolved in 100 mL of water and consumed three times a day for 3 days, with a further dose in the morning of the scan. This preparation technique was previously offered to frail patients at this trust as a less invasive and time-consuming alternative to CT (virtual) colonoscopy, which was not available during the early phases of the pandemic over concerns regarding COVID-19 transmission. The CT findings were categorised as high risk where there were features highly suggestive of a cancer, medium risk when non-specific findings such as bowel wall thickening were found and low risk when the scan was reported as normal. Colonic mass lesions on CT were considered highly predictive of CRC and beneficial in endoscopy prioritisation, allowing earlier diagnosis and treatment.

Prioritisation of patients

The second stage of the triage pathway prioritised the urgency of LGI endoscopy based on the FIT test result, CT findings, clinical symptoms and whether they had undergone a colonoscopy in the last 3 years. A higher priority was also applied to those who had a prolonged delay in investigation, as delays in CRC diagnosis are associated with worse outcomes. This composite score was used to assign a level of endoscopy prioritisation (EP) as either EP1, EP2, EP3 or EP4 with EP1 having the greatest priority and EP4 having the lowest priority (Table 2). The composition of groups was chosen based on the perceived cancer risk in each group and the endoscopy capacity.

Table 1 Risk of CRC based on FIT, Hb and symptoms

| Risk of CRC | Symptoms                                                                 |
|-------------|--------------------------------------------------------------------------|
| High risk   | FIT >60 μgHb/g                                                          |
|             | Where FIT not available                                                  |
|             | IDA with Hb <10 g/L                                                      |
|             | Rectal bleeding with;                                                   |
|             | Change in bowel habit, IDA, weight loss or abdominal pain                |
|             | IDA with;                                                               |
|             | Weight loss, abdominal pain or a change in bowel habit                   |
| Standard risk | FIT 10–59.9 μgHb/g unless palpable mass                                 |
|             | Isolated IDA with Hb ≥10 g/L                                              |
|             | Isolated symptoms                                                       |
| Low risk    | FIT <10 μgHb/g unless palpable mass                                      |
|             | Colonoscopy in last 3 years                                              |
|             | Symptoms not fulfilling NICE guideline NG12 criteria                     |

CRC, colorectal cancer; FIT, faecal immunochemical test; Hb, haemoglobin; IDA, iron deficiency anaemia.

Archer T, et al. Frontline Gastroenterology 2021;0:1–6. doi:10.1136/flgastro-2021-101825
with significance set at a p value of <0.05. Categorical variables were summarised by descriptive statistics, including total numbers, percentages and relative risk with comparisons between groups performed using the $\chi^2$ test or Fisher’s exact test. Continuous variables were summarised by mean and SD.

Secondary outcome measures include alternative diagnoses such as inflammatory bowel disease, a non-colonic cancer and advanced polyps (defined as a polyp $>$1 cm, with high-grade dysplasia or villous histology). Univariate and multivariate binomial regressions using backward elimination were used to demonstrate factors associated with a CRC.

**RESULTS**

There were 514 patients referred for an LGI endoscopy during the study period (figure 1). There was an equal gender representation with 257 (50%) males and a mean (SD) age of 64.5 years (12.7 years). An FIT test was available in 194 patients (37.7%) with 40/194 (20.6%) having a result $>$100 μgHb/g, 7/194 (3.6%) had an FIT 60–99 μgHb/g, 79/194 (40.7%) had an FIT 10–59 μgHb/g and 68/194 (35.1%) had an FIT $<$10 μgHb/g.

The most common reason for referral was a change in bowel habit (47%) with a smaller proportion of patients having abdominal pain (27%), rectal bleeding (25%), IDA (23%) and weight loss (15%), with 43% having a combination of symptoms.

The first stage of the triage pathway judged the risk of CRC to be high in 190/514 patients (37.0%), standard in 274/514 patients (53.3%) and low in 50/514 patients (9.7%).

**CT findings**

Radiological imaging with a CT was performed in 195/514 patients (37.9%), of whom 158 subsequently had an LGI endoscopy. CT findings highly suspicious of cancer were reported in 15/195 patients (7.7%). Non-specific findings such as bowel wall thickening were reported in 18/195 patients (9.2%). Polyps were reported in two patients.

**Prioritisation of colonoscopy**

Following initial referral, 422/514 patients (82%) underwent a LGI endoscopy (see online supplemental information 1 for reasons patients did not proceed to endoscopy). The second stage of the triage pathway allocated 52/422 patients (12.3%) to the EP1 group with 105/422 (24.9%), 210/422 (49.8%) and 55/422 (13.0%) to the EP2, EP3 and EP4 groups, respectively.

**Figure 1** Study flow chart demonstrating proportion of patients deemed to be at high risk of CRC, CT scan provision and subsequent prioritisation of endoscopy. 2ww, 2-week wait; CRC, colorectal cancer; EP, endoscopy prioritisation; FIT, faecal immunochemical test; LGI, lower gastrointestinal.
Colorectal (13.0%) allocated to the EP2, EP3 and EP4 groups, respectively.

CRCs detected
CRC was detected in 22/422 patients (5.2%) who underwent endoscopy, with one further CRC detected at CT and operated on without undergoing LGI endoscopy. The mean (SD) age of patients with CRC was 70 years and 18/23 patients (78.3%) were male. Cancers were found in all parts of the colon with nine patients (39.1%) had rectal cancer, six patients (26.1%) had right-sided cancer, six patients (26.1%) had left-sided cancer, one patient had synchronous left-side and right-side cancers and one patient had anal cancer. When CT findings highly suggestive of CRC were reported, 13/15 patients (86.7%) were subsequently found to have cancer. A cancer was also found in a patient in whom a polyp was reported after CT imaging. No CRC was found in any of the patients with a normal CT report or with non-specific thickening. In the nine patients whose CRC were initially detected during endoscopy without a prior CT, six were seen on the subsequent staging CT and the other three had polyp cancers, which had all been removed prior to CT.

Patients categorised as having a high risk of CRC, based on FIT and clinical symptoms, had an increased prevalence of CRC 18/190 (9.5%) compared with those triaged as standard risk 5/274 (1.8%) (relative risk (RR)=5.2, 95%CI=2.0–13.7, p<0.001). There were no cancers in the low-risk group.

The second stage of the triage pathway, endoscopy prioritisation, performed well with a significantly higher prevalence of cancer in the EP1 group (12/52 patients (23.1%), RR=16.2, 95%CI 5.1 to 51.7, p<0.001) and EP2 group (7/105 patients (6.7%), RR=4.7, 95%CI 1.34 to 16.3, p=0.018) compared with the EP3 priority group (3/210 patients (1.4%)) (table 3).

Prior to recommencement of endoscopic services, 39 LGI endoscopies were performed by exception. Of these, CRC was diagnosed in eight patients (20.5%), of which seven had a prior CT suggestive of cancer.

Non-CRC findings
Advanced polyps were found in 47/400 patients (11.8%) who did not have CRC. Inflammatory bowel disease was diagnosed in 12/422 patients (2.8%). Relevant extra colonic disease was found in 9/514 patients (1.8%), including 7 cancers (1 pleural, 2 renal cell, 1 cholangiocarcinoma, 1 hepatocellular, 1 pancreatic and 1 small intestinal neuroendocrine tumour) as well as 1 case of peritoneal tuberculosis and 1 of sarcoidosis.

Symptoms and FIT results
Most patients with CRC presented with a combination of symptoms (15/23 (65.2%)) rather than isolated symptoms (8/23 (34.8%)). The relationship between clinical symptoms and CRC is summarised in online supplemental information 2. FIT testing had been performed in 11/23 patients (47.8%) diagnosed with CRC. The FIT result was ≥10 μgHb/g in 10/11 of these patients and was >60 μgHb/g in 6/11 patients. The single patient with an FIT <10 μgHb/g had a palpable rectal cancer. The positive predictive value for an FIT >60 μgHb/g was 13% with a negative predictive value of 98.1% for an FIT <10 μgHb/g.

Regression analysis
Factors associated with CRC diagnosis on univariate analysis were male sex, increasing age, an FIT >60 μgHb/g and >100 μgHb/g, increasing number of symptoms, IDA with abdominal pain, rectal bleeding with abdominal pain and rectal bleeding with weight loss. Multivariate logistic regression analysis found that an FIT >100 μgHb/g and rectal bleeding with weight loss remained independently associated with the presence of CRC (online supplemental file 3).

Patients not undergoing LGI endoscopy
LGI endoscopy was not performed in 92/514 patients (17.9%). Of these, CT imaging had been performed in 37/92 patients (40.2%) and 28/92 patients (30.4%) had undergone FIT analysis. This was <10 μgHb/g in 15/28 patients (53.6%), 10–60 μgHb/g in 11/28 patients (44%) and >60 μgHb/g in 2/28 patients (7.1%). The most common reason why endoscopy was not performed was patient choice to defer due to concerns regarding transmission of COVID-19 (see online supplemental file 1).

DISCUSSION
The COVID-19 pandemic dramatically limited the provision of endoscopy services. Therefore, a prioritisation system was required to minimise delays in cancer diagnosis. We used the availability of CT imaging to assess for evidence of CRC in those at

| Prioritisation group | Number LGI endoscopy performed | Number diagnosed with CRC | Percentage diagnosed with CRC | Relative risk (95%CI) |
|----------------------|-------------------------------|---------------------------|-------------------------------|-----------------------|
| EP1                  | 52                            | 12                        | 23.1                          | 16.2 (5.1 to 51.7)    |
| EP2                  | 105                           | 7                         | 6.7                           | 4.7 (1.3 to 16.3)     |
| EP3                  | 210                           | 3                         | 1.4                           | 1                     |
| EP4                  | 55                            | 0                         | 0                             | 0 (0 to 4.7)          |

CRC, colorectal cancer; EP, endoscopy prioritisation; LGI, lower gastrointestinal.
highest risk and minimise diagnostic delays. This pragmatic approach prioritised more than half of all CRC cases to the most urgent group, which comprised of only a tenth of the patients. Most of the remaining cancers were in the next highest priority group leaving only 13% of CRC patients in the EP3 group.

This is the first study to describe the outcomes of an endoscopy prioritisation system that considered the results of CT imaging alongside clinical symptoms and FIT results. There were no CRCs detected in patients whose CT scans were reported as normal; however, 37 of these patients did not undergo endoscopy. Although this strategy may have missed patients with early or small cancers, it suggests that in the setting of reduced endoscopy capacity a CT examination in those at high risk of CRC based on FIT and clinical symptoms is a reasonable strategy to reduce time to diagnosis. This provides reassurances to both patients and relevant stakeholders regarding investigating safely and in a timely manner. The downside of this strategy is the additional burden on radiology departments and increased exposure to ionising radiation, as just over a third of patients had high-risk features based on symptoms and FIT results. There are also additional resources associated with the risk prioritisation process, although this would be minimised by a greater use of FIT testing.

Based on FIT alone, 10 of the 11 patients with CRC would have been detected at a level ≥10 μgHb/g and the single patient with an FIT <10 μgHb/g had a palpable rectal cancer. The limitation of FIT in patients with rectal lesions is well recognised and the findings at rectal examination should be considered alongside the FIT result.44 Our data is consistent with the findings of previous studies which have reported a sensitivity of 90.9%–97% and a negative predictive value (NPV) of 99.8%–98.9%, with an FIT of 10–150 μgHb/g. This supports the use of a FIT level <10 μgHb/g in combination with a normal rectal examination as a safe method to exclude patients from a cancer pathway.

Despite communications to primary care clinicians and subsequent patient letters, disappointingly, an FIT result was available in only 38% of patients. Maclean et al demonstrated FIT results could be obtained in over 94% of referrals by sending the kit directly to patients and, using a 10 μgHb/g cut-off, a half of the patients were excluded from further investigations.16 If this were applied in our cohort, 35.7% of the patients with an FIT result would have been excluded. We believe FIT testing should be considered imperative for all 2ww referrals without a mass or rectal bleeding, and we recognise this was recommended by a recent independent review of diagnostic services for NHS England.17

Almost a fifth of patients did not proceed to endoscopy following referral. Patient choice was the reason in over half of cases with 20.6% deferring due to the pandemic. Anxiety to undergo endoscopy during the pandemic has been described.18 This high rate of incomplete investigations is a further indication of this. However, this concern does not appear to be justified, with a UK multicentre study of 6208 patients, undertaken after the first lockdown, reporting no cases of COVID-19 transmission.19 The long-term outcomes associated with decisions to decline investigation were uncertain and worthy of further research.

Abnormalities were seen on the CT of all 13 patients who underwent CT before endoscopic confirmation of CRC.12 However, 37 patients did not go on to have LGI endoscopy after their CT. Studies of CT examinations have reported a CRC miss rate between 0% and 30%, and this predominantly relates to the early CRC associated with the best prognosis.9–11 Therefore, if there were significant endoscopy restrictions again, we would advocate CT with oral contrast as an endoscopy prioritisation tool but not a definitive method of CRC exclusion.

This study was limited to a single centre and 23 patients with CRC. Planning a coordinated response with little notice during the height of a pandemic is challenging. Regardless, FIT and CT imaging are widely available and, therefore, the study outcome is applicable to many centres.

A major strength of this study is that it is a ‘real-world’ prospective study with incomplete endoscopy investigations highlighting patient concern related to COVID-19 during hospital attendance. Accepting these limitations, this prioritisation strategy effectively allocated most patients with CRC to the highest endoscopy priority groups.

CONCLUSION

The COVID-19 pandemic has, and continues, to affect the delivery of endoscopy services. Utilisation of CT imaging in those at highest risk of CRC is an effective strategy to prioritise endoscopy during a period of limited endoscopy capacity.

Contributors TA: data curation, formal analysis, investigation, project administration and writing. IA, MK and VK: data curation, investigation and writing. AB: conceptualisation, formal analysis, investigation, project administration and writing.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This work commenced following ethical approval and registration with STH NHS FT (reference number: STH21506) and the Health Research Authority and Health and Care Research Wales (reference number: 20/ HRA/4866).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Anonymised data from the study can be requested from the author by emailing thomas.archer@nhs.net.
Colorectal

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REFERENCES
1 BSG, JAG. Endoscopy activity and COVID-19: BSG and JAG guidance, 2020. Available: https://www.bsg.org.uk/covid-19-advice/endoscopy-activity-and-covid-19-bsg-and-jag-guidance/
2 ACPGBI, BSG, BSGAR. Joint ACPGBI, BSG and BSGAR considerations for adapting the rapid access colorectal cancer pathway during COVID-19 pandemic. The British Society of Gastroenterology, 2020.
3 Godber IM, Todd LM, Fraser CG, et al. Use of a faecal immunochemical test for haemoglobin can aid in the investigation of patients with lower abdominal symptoms. Clin Chem Lab Med 2016;54:595–602.
4 Westwood M, Lang S, Armstrong N, et al. Faecal immunochemical tests (fit) can help to rule out colorectal cancer in patients presenting in primary care with lower abdominal symptoms: a systematic review conducted to inform new NICE DG30 diagnostic guidance. BMC Med 2017;15:189.
5 D’Souza N, Georgiou Delisle T, Chen M, et al. Faecal immunochemical test is superior to symptoms in predicting pathology in patients with suspected colorectal cancer symptoms referred on a 2WW pathway: a diagnostic accuracy study. Gut 2021;70:1130–8.
6 Astin M, Griffin T, Neal RD, et al. The diagnostic value of symptoms for colorectal cancer in primary care: a systematic review. Br J Gen Pract 2011;61:e231–43.
7 Hamilton W, Lancashire R, Sharp D, et al. The risk of colorectal cancer with symptoms at different ages and between the sexes: a case-control study. BMC Med 2009;7:17.
8 Claringburn T, Bailey J, Weller J, et al. FIT and blood tests for prioritisation of urgent colorectal cancer referrals in symptomatic patients: a two year evaluation. British Journal of Surgery.
9 Ozel B, Pickhardt PJ, Kim DH, et al. Accuracy of routine nontargeted CT without colonography technique for the detection of large colorectal polyps and cancer. Dis Colon Rectum 2010;53:911–8.
10 Ng CS, Doyle TC, Pinto EM, et al. Evaluation of CT in identifying colorectal carcinoma in the frail and disabled patient. Eur Radiol 2002;12:2988–97.
11 Colvin H, Lukram A, Sohail I, et al. The performance of routine computed tomography for the detection of colorectal cancer. Ann R Coll Surg Engl 2013;95:473–6.
12 Ganeshan A, Upponi S, Uberoi R, et al. Minimal-preparation CT colon in detection of colonic cancer, the Oxford experience. Age Ageing 2007;36:48–52.
13 Loveday C, Sud A, Jones ME, et al. Prioritisation by FIT to mitigate the impact of delays in the 2-week wait colorectal cancer referral pathway during the COVID-19 pandemic: a UK modelling study. Gut 2021;70:1053–60.
14 Rutter MD, Brookes M, Lee TJ, et al. Impact of the COVID-19 pandemic on UK endoscopic activity and cancer detection: a national endoscopy database analysis. Gut 2021;70:537–43.
15 Chapman C, Bunce J, Oliver S, et al. Service evaluation of faecal immunochemical testing and anaemia for risk stratification in the 2-week-wait pathway for colorectal cancer. BJS Open 2019;3:395–402.
16 Maclean W, Limb C, Mackenzie P, et al. Adoption of faecal immunochemical testing for 2-week-wait colorectal patients during the COVID-19 pandemic: an observational cohort study reporting a new service at a regional centre. Colorectal Dis 2020. doi:10.1111/codi.15408. [Epub ahead of print: 17 Oct 2020].
17 Richards M. Diagnostics: recovery and renewal – report of the independent review of diagnostic services for NHS England. NHS England, 2020.
18 Armellini E, Repici A, Alvisi C, et al. Analysis of patients attitude to undergo urgent endoscopic procedures during COVID-19 outbreak in Italy. Dig Liver Dis 2020;52:695–9.
19 Hayee Bu’Hussain, East J, et al. SCOTS project group. Multicentre prospective study of COVID-19 transmission following outpatient GI endoscopy in the UK. Gut 2021;70:825–8.
| Reason LGI endoscopy not performed | Number |
|-----------------------------------|--------|
| Patient cancelled investigation    | 26     |
| Deferred until after COVID-19 pandemic | 19     |
| Clinician decision after CT scan  | 15     |
| Patient decision after CT scan    | 12     |
| Did not attend colonoscopy appointment | 9     |
| Colonoscopy performed at different centre | 4     |
| No reason given                    | 3      |
| Patient died prior to colonoscopy | 2      |
| Patient declined to have pre colonoscopy COVID-19 swab | 2 |

**Supplemental table 1** Reasons why patients did not have a colonoscopy performed
| Investigations                  | Number of cohort (%) | Sensitivity % (95% CI) | Specificity % (95% CI) | PPV % (95% CI) | NPV % (95% CI) |
|--------------------------------|----------------------|------------------------|------------------------|---------------|---------------|
| FIT ≥10 μgHb/g                 | 166 (39)             | 90.9 (62.3-99.5)       | 33.6 (26.4-41.3)       | 8.9 (4.9-15.5) | 98.1 (90.1-99.9) |
| FIT >60 μgHb/g                 | 223 (52.7)           | 54.6 (23.0-78.7)       | 74.2 (66.8-80.2)       | 13.0 (6.1-25.7) | 95.8 (90.6-98.2) |
| FIT > 100 μgHb/g               | 125 (29.6)           | 54.6 (28-78.7)         | 78.7 (71.6-84.4)       | 15.4 (7.2-29.7) | 96.1 (91.1-98.3) |
| CT scan                        | 158 (37.3)           | 100 (78.5-100)         | 84.7 (78.0-89.7)       | 38.9 (24.8-55.1) | 100 (97.0-100)  |
| CIBH                           | 123 (29.1)           | 47.8 (29.2-67.0)       | 47.0 (42.2-51.9)       | 4.9 (2.8-8.6)  | 94.0 (89.8-96.5) |
| IDA                            | 123 (29.1)           | 39.1 (22.2-59.2)       | 71 (66.4-75.2)         | 7.2 (3.8-13.2) | 95.3 (92.3-97.2) |
| Rectal bleeding                | 123 (30.7)           | 47.8 (29.2-67)         | 70.3 (65.6-74.5)       | 8.5 (4.8-14.5) | 95.9 (93-97.6)  |
| Abdominal pain                 | 123 (29.1)           | 34.8 (18.8-55.1)       | 71.3 (66.6-75.5)       | 6.5 (3.3-12.3) | 95.0 (91.9-97.0) |
| Weight loss                    | 82 (19.2)            | 34.8 (18.8-55.1)       | 81.5 (77.4-85)         | 9.8 (5-18.1)   | 95.6 (92.9-97.3) |

| Combination of symptoms        |                      |                        |                        |               |               |
|--------------------------------|----------------------|------------------------|------------------------|---------------|---------------|
| Rectal bleeding + IDA          | 16 (3.8)             | 8.7 (1.5-26.8)         | 96.5 (94.2-97.9)       | 12.5 (2.2-36.0) | 94.8 (92.2-96.6) |
| Rectal bleeding + abdominal pain | 41 (9.7)       | 26.1 (12.6-46.5)       | 91.3 (88.1-93.5)       | 14.6 (6.9-28.4) | 95.6 (93 – 97.2) |
| Rectal bleeding + weight loss  | 21 (5.0)             | 17.4 (7.0-37.1)        | 95.8 (93.3-97.3)       | 19.1 (7.7-40.0) | 95.3 (92.7-97.0) |
| Rectal bleeding + CIBH         | 63 (14.9)            | 26.1 (12.6-46.5)       | 85.8 (82.0-88.9)       | 9.5 (4.4-19.3) | 95.3 (92.6-97.0) |
| IDA + abdominal pain           | 9 (2.1)              | 8.7 (1.5-26.8)         | 98.3 (96.4-99.2)       | 22.2 (3.9-54.7) | 94.9 (92.4-96.7) |
| IDA + weight loss              | 12 (2.8)             | 8.7 (1.5-26.8)         | 97.8 (95.8-98.8)       | 18.2 (3.2-47.7) | 95.0 (92.3-96.6) |
| IDA + CIBH                     | 22 (5.2)             | 8.7 (1.5-26.8)         | 95.0 (92.4-96.7)       | 9.1 (1.6-27.8) | 94.8 (92.1-96.6) |

**Supplemental table 2** - Value of investigations and symptoms for patients in diagnosing CRC in those who had a LGI endoscopy (*a* positive CT scan included both features highly suggestive of CRC as well as non specific abnormalities such as bowel wall thickening)
### Univariate regression of association with CRC

| Factor                                           | Odds ratio | 95% CI          | P value |
|--------------------------------------------------|------------|-----------------|---------|
| FIT ≥ 10 µHb/g                                   | 2.588      | 0.9860 to 8.118 | 0.0713  |
| Fit > 60 µHb/g                                   | 3.454      | 0.9905 to 12.56 | 0.0499  |
| FIT > 100 µHb/g                                  | 4.412      | 1.257 to 16.16  | 0.0195  |
| Age                                             | 1.044      | 1.005 to 1.090  | 0.0383  |
| Male sex                                         | 3.947      | 1.542 to 12.13  | 0.0077  |
| Change in bowel habit                           | 0.8360     | 0.3552 to 1.949 | 0.6763  |
| IDA                                             | 1.551      | 0.6310 to 3.634 | 0.3191  |
| Rectal bleeding                                 | 2.249      | 0.9515 to 5.270 | 0.0602  |
| Abdominal pain                                  | 1.320      | 0.5193 to 3.123 | 0.5386  |
| Weight loss                                     | 2.200      | 0.8598 to 5.250 | 0.0832  |
| Number of symptoms                              | 1.663      | 1.080 to 2.538  | 0.0186  |
| Rectal bleeding + change in bowel habit         | 2.204      | 0.7690 to 5.556 | 0.1109  |
| Rectal bleeding + IDA                           | 2.714      | 0.4095 to 10.59 | 0.2053  |
| Rectal bleeding + abdominal pain                 | 3.812      | 1.307 to 9.849  | 0.0083  |
| Rectal bleeding + weight loss                    | 4.904      | 1.317 to 14.86  | 0.0084  |
| IDA + change in bowel habit                      | 1.910      | 0.2923 to 7.198 | 0.4047  |
| IDA + abdominal pain                             | 6.254      | 0.8809 to 29.10 | 0.0304  |
| IDA + weight loss                                | 4.138      | 0.6061 to 17.37 | 0.0808  |

### Multivariate regression of association with CRC

| Factors                                           | Odds ratio | 95% confidence interval | P value |
|--------------------------------------------------|------------|-------------------------|---------|
| FIT >100 µHb/g                                   | 4.495      | 1.224 to 17.45          | 0.0231  |
| Rectal bleeding + weight loss                    | 8.366      | 1.484 to 41.39          | 0.0098  |

**Supplemental table 3 -** Univariate and multivariate regression for association with CRC