Received: 1 April 2022 | Revised: 20 June 2022 | Accepted: 24 June 2022

DOI: 10.1111/codi.16240

ORIGINAL ARTICLE

Prevalence of repeat faecal immunochemical testing in symptomatic patients attending primary care

Mark S. Johnstone[1] | Campbell MacLeod[2] | Jayne Digby[3] | Yassir Al-Azzawi[1] | Grace Pang[1] | Angus J. M. Watson[2] | Judith Strachan[4] | Craig Mowat[5] | Stephen T. McSorley[1]

[1]Academic Unit of Surgery, School of Medicine, Dentistry and Nursing, University of Glasgow, Glasgow, UK

[2]Department of Surgery, Raigmore Hospital, Inverness, UK

[3]Centre for Research into Cancer Prevention and Screening, School of Medicine, Ninewells, Hospital and Medical School, University of Dundee, Dundee, UK

[4]Department of Blood Sciences, Ninewells Hospital and Medical School, Dundee, UK

[5]Population Health & Genomics, School of Medicine, Ninewells Hospital and Medical School, University of Dundee, Dundee, UK

Correspondence
Mark S. Johnstone, Academic Unit of Surgery, School of Medicine, Dentistry and Nursing, University of Glasgow, New Lister Building, Glasgow Royal Infirmary, 8–16 Alexandra Parade, Glasgow G31 2ER, UK.
Email: mark.johnstone.2@glasgow.ac.uk

Abstract

Aim: The faecal immunochemical test (FIT) for faecal haemoglobin (f-Hb) helps determine the risk of colorectal cancer (CRC) and has been integrated into symptomatic referral pathways. 'Safety netting' advice includes considering referral for persistent symptoms, but no published data exists on repeated FITs. We aimed to examine the prevalence of serial FITs in primary care and CRC risk in these patients.

Method: A multicentre, retrospective, observational study was conducted of patients with two or more consecutive f-Hb results within a year from three Scottish Health Boards which utilize FIT in primary care. Cancer registry data ensured identification of CRC cases.

Results: Overall, 135 396 FIT results were reviewed, of which 12 359 were serial results reported within 12 months (9.1%), derived from 5761 patients. Of these, 42 (0.7%) were diagnosed with CRC. A total of 3487 (60.5%) patients had two f-Hb < 10 μg/g, 944 (16.4%) had f-Hb ≥ 10 μg/g followed by <10 μg/g, 704 (12.2%) f-Hb < 10 μg/g followed by ≥10 μg/g and 626 (10.9%) had two f-Hb ≥ 10 μg/g. The CRC rate in each group was 0.1%, 0.4%, 1.4% and 4.0%, respectively. Seven hundred and thirty four patients submitted more than two FITs within a year. The likelihood of one or more f-Hb ≥ 10 μg/g rose from 40.4% with two samples to 100% with six, while the CRC rate fell from 0.8% to 0%.

Conclusion: Serial FITs within a year account for 9.1% of all results in our Boards. CRC prevalence amongst symptomatic patients with serial FIT is lower than in single-FIT cohorts. Performing two FITs within a year for patients with persistent symptoms effectively acts as a safety net, while performing more than two within this timeframe is unlikely to be beneficial.

KEYWORDS
cancer, colorectal, faecal, FIT, immunochemical, repeat, serial, symptomatic, test

INTRODUCTION

The faecal immunochemical test (FIT) is an accurate method for predicting the risk of colorectal cancer (CRC) in symptomatic patients prior to consideration of other lower gastrointestinal (GI) investigations. While symptoms trigger assessment, they are themselves poor predictors of CRC [1, 2]. The FIT has shown superior accuracy, with sensitivity and specificity reportedly ranging from 85% to 100% and 56% to 91%, respectively, at a faecal haemoglobin (f-Hb) threshold of ≥10 μg Hb/g faeces [3–10]. The National Institute for Health and Care Excellence (NICE) now recommend that the FIT be used in patients with high-risk symptoms that may trigger an urgent suspected cancer referral (NG12) [11] and in those with lower-risk symptoms (DG30) [12] at a threshold of 10 μg Hb/g. Twelve Health Boards across Scotland have now embedded FIT testing within their symptomatic lower GI referral pathways as an adjunct to clinical acumen and a full blood count result [2, 13, 14]. Local guidance recommends 'safety netting' including consideration of referral for persisting symptoms, but there is no specific guidance on repeating the FIT test in the absence of any published data to support this.

As general practitioners (GPs) now have access to the FIT we have noted that laboratory databases contain a number of patients who have accrued multiple f-Hb results over time. To date, no studies have examined the implications and utility of serial FITs. We therefore aimed to examine the relationship between serial f-Hb concentrations and the risk of CRC in symptomatic patients.

What does this paper add to the literature?

Publications to date have focused on a single FIT in patients with lower gastrointestinal symptoms. For those with a f-Hb < 10 μg/g but persistent symptoms, safety netting is advised. No guidance exists on serial FITs. This is the first study to examine serial FITs in symptomatic patients and the associated incidence of colorectal cancer.

METHOD

A multicentre, retrospective, observational study was conducted of symptomatic patients within three Scottish Health Boards: NHS Greater Glasgow and Clyde (GG&C) (first f-Hb measurement collected between September 2018 and December 2020), NHS Tayside (December 2015 to December 2020) and NHS Highland (December 2018 to October 2021). Each Health Board issues similar guidance on the utility of the FIT in primary care within their symptomatic lower GI referral pathways (Figure S1).

Faecal immunochemical test specimen collection and handling

The FIT collection kits were supplied to GPs. Each contains a single FIT collection device (EXTEL HEMO-AUTO MC Collection Picker, Minaris Medical Co., Ltd, supplied by Alpha Labs Ltd), pictorial instructions and a return envelope. The collection device is a picker which obtains a consistent 2 mg sample and is inserted into a vial containing 2 ml of buffer. Patients being considered for symptomatic lower GI referral were asked to collect a single faecal sample and return it to their GP practice as soon as possible. The samples were transported at ambient temperature via routine specimen collection services and stored at 4°C prior to analysis in centralized laboratories (Stobhill Hospital, Glasgow for NHS GG&C, Ninewells Hospital, Dundee for Tayside and Highlands).

Faecal immunochemical test analysis

The HM-JACKarc system (Minaris Medical Co., Ltd) was in operation from Mondays to Fridays so most samples were analysed on the day of receipt. The manufacturers give a limit of detection of 2 μg/g, a limit of quantification of 7 μg/g and an upper measurement limit of 400 μg/g. Specimens with f-Hb concentrations above this limit were not diluted and re-analysed.

Faecal immunochemical test result quality management

All biomedical science staff in each laboratory are registered with the Health Care and Professionals Council (HCPC) and undergo local competency assessment prior to using the HM-JACKarc analyser. There are two internal quality controls (IQCs): EXTEL HEMO AUTO HS Low IQC and EXTEL HEMO AUTO HS High IQC. West guard rule criteria are used for the acceptance or rejection of analytical runs. The laboratories participate in appropriate external quality assessment.

Faecal immunochemical test result handling

The FIT results are electronically transferred from the analyser into the Laboratory Information Management System and patient record as well as being electronically reported to the requesting GP. FIT results ≥10 μg/g were defined as raised as per the NICE DG30 guidance [12] and GPs are asked to use the f-Hb measurement to guide the need for referral to specialist services.

Patient identification and data collection

To identify study participants a search of the clinical biochemistry repository in each Health Board was conducted. Patients with two or more consecutive f-Hb measurements with an interval between

samples of 1 week to 1 year were included. Patients were excluded if they were <16 years old, they had fewer than two valid f-Hb measurements, if they attended colonoscopy in between their two FIT result dates or if they had a previous diagnosis of CRC. To obtain patient demographics and outcomes, cross-referencing of the electronic patient record including referral letters, endoscopy, pathology and radiology reports was performed with the Community Health Index number used as the linkage variable. Demographics and bloods results were recorded at the date of the first FIT or as close to it as possible. To ensure no CRC diagnoses were missed, the Scottish Cancer Registry as well as regional cancer audit datasets were searched to identify all new diagnoses of CRC up to August 2021. This allowed identification of CRC cases diagnosed outside the referral pathways under examination by this study. Caldicott guardian approval was given by each Health Board to safeguard the record linkage with ethical approval waived for the purposes of service development. As the study was retrospective and observational and had no impact on patient care, consent was not obtained from each patient.

Data analysis

An elevated f-Hb was defined as ≥10 μg/g as per NICE DG30 [12]. Serial FIT measurements were categorized into four groups: two consecutive f-Hb results <10 μg/g, a f-Hb ≥ 10 μg/g followed by a f-Hb < 10 μg/g, a f-Hb < 10 μg/g followed by a f-Hb ≥ 10 μg/g and two consecutive f-Hb results ≥ 10 μg/g. The definition of anaemia on full blood count was based on World Health Organization guidelines (male Hb < 130 g/L, female Hb < 120 g/L) [15]. Patients diagnosed with CRC who had an initial f-Hb < 10 μg/g were examined separately. Data analysis in GG&C, Tayside and Highland was performed using SPSS software (SPSS Inc.). Amalgamation of the data was performed in Microsoft Excel (Microsoft). Categorical data were compared using cross-tabulation and the chi square test or Fisher's exact test. Continuous data were compared using analysis of variance. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Study cohort

During the study period a total of 70 250 valid FIT results were issued in symptomatic patients in primary care in NHS GG&C, 50 186 in NHS Tayside and 14 960 in NHS Highland. This gave a combined total of 135 396. Of these, 12 359 were serial results reported within 12 months and derived from 5761 patients: 5027 patients had two FIT samples taken within 12 months, 649 had three samples, 71 four, 10 five and 4 patients six. All these patients with two or more consecutive f-Hb measurements within a year were included in the final analysis. The proportion of male to female patients was similar between all three Health Boards, while patients in NHS GG&C were significantly younger ($p < 0.001$) and follow-up was significantly shorter in NHS Highland ($p < 0.001$; Table 1). 42 (0.7%) patients were found to have CRC.

Serial f-Hb

Comparing the first two consecutive valid FITs for all patients, 3487 (60.5%) had two f-Hb results <10 μg/g: of these, three patients (0.1%) were subsequently diagnosed with CRC (Table 2). By comparison, 626 (10.9%) had two f-Hb results ≥10 μg/g, of whom 25 (4.0%) were subsequently diagnosed with CRC. Those patients with a f-Hb result ≥10 μg/g followed by a f-Hb result <10 μg/g and a f-Hb result <10 μg/g followed by a f-Hb result ≥10 μg/g also had an increased risk of CRC (0.4% and 1.4%, respectively; $p < 0.001$).

TABLE 1 Demographics, median interval between faecal immunochemical tests (FITs) and incidence of colorectal cancer in symptomatic patients with more than one FIT test result in a 12-month period

	NHS Board			
	NHS GG&C	NHS Tayside	NHS Highland	*p*
Total	3018	1789	954	–
Sex				
Male	1212 (40.2%)	781 (43.7%)	390 (40.9%)	0.289
Female	1806 (59.8%)	1008 (56.3%)	564 (59.1%)	
Age (years)				
Median (IQR)	63 (52–74)	69 (56–78)	69 (57–77)	<0.001
Interval between first and second f-Hb (months)				
Median (IQR)	5 (2–8)	6 (2–9)	5 (1–8)	<0.001
Follow-up (months)				
Median (IQR)	18 (12–23)	24 (36–43)	9 (5–15)	<0.001
CRC cases	15 (0.5%)	19 (1.1%)	8 (0.8%)	0.162

Abbreviations: CRC, colorectal cancer; f-Hb, faecal haemoglobin; GG&C, Greater Glasgow and Clyde; IQR, interquartile range.

TABLE 2 Comparison between serial FIT categorical result of serial faecal immunochemical tests (threshold of ≥10 μg/g) and colorectal cancer risk

	Serial FIT				Total	p
First FIT	<10 μg/g	≥10 μg/g	<10 μg/g	≥10 μg/g		
Second FIT	<10 μg/g	<10 μg/g	≥10 μg/g	≥10 μg/g		
All patients	3487	944	704	626	5761	<0.001
CRC	3 (0.1%)	4 (0.4%)	10 (1.4%)	25 (4.0%)	42 (0.7%)	

Abbreviations: CRC, colorectal cancer; f-Hb, faecal haemoglobin; FIT, faecal immunochemical test.

TABLE 3 Comparison between number of faecal immunochemical test samples within 12 months and colorectal cancer rate

	Number of FIT tests within 12 months						
	Two	Three	Four	Five	Six	Total	*p*
n	5027	649	71	10	4	5761	–
At least one f-Hb ≥10 μg/g	2032 (40.4%)	290 (44.7%)	31 (43.7%)	6 (60.0%)	4 (100%)	2363 (41.0%)	0.121
CRC	40 (0.8%)	2 (0.3%)	0 (0%)	0 (0%)	0 (0%)	42 (0.7%)	0.362

Abbreviations: CRC, colorectal cancer; f-Hb, faecal haemoglobin; FIT, faecal immunochemical test.

Number of f-Hb samples

Table 3 shows a comparison between the number of FIT results within 12 months and CRC rate. The likelihood of at least one f-Hb ≥ 10 μg/g rose from 40.4% with two samples to 100% with six samples, while the CRC rate fell from 0.8% with two samples to 0% with four or more samples.

Colorectal cancer with first f-Hb < 10 μg/g

The demographics and pathology of the 13 patients diagnosed with CRC whose first f-Hb < 10 μg/g are reviewed (Table 4). Eight of thirteen (62%) patients had tumours proximal to the splenic flexure. Ten of thirteen (77%) had an anaemia on full blood count at the time of the first FIT.

DISCUSSION

To date, evidence-based practice guidance has focused on the utility of a single FIT when patients present to primary care with new bowel symptoms. Safety-netting advice has recommended re-assessment of those with persisting symptoms, without any specific advice on further FITs in the absence of published data. For the first time, to our knowledge, we have reported the prevalence of serial FITs in a symptomatic population. We have filled an important gap in the current literature by examining the incidence rate of CRC by serial f-Hb results. In the current study, patients with two consecutive f-Hb results <10 μg/g had a very low CRC risk (0.1%). In addition, only 0.4% of patients with a f-Hb ≥ 10 μg/g followed by f-Hb < 10 μg/g were found to have CRC, although the reason for the second FIT rather than colonoscopy/colon capsule endoscopy (CCE)/ cross-sectional imaging following the first FIT results was not known. Perhaps such patients were deemed very low risk for CRC and the FIT was repeated to ensure it was not persistently elevated. These results should provide reassurance to GPs and secondary-care practitioners who triage patients for referral and investigation. In these patients, further investigation should be determined by the reason for referral and with the aim of symptom improvement, rather than to exclude CRC. In contrast, two consecutive f-Hbs ≥ 10 μg/g or a f-Hb result <10 μg/g followed by f-Hb result ≥10 μg/g were associated with a significantly higher risk of CRC (4.0% and 1.4%, respectively) and these patients should be prioritized for referral and urgent colonoscopy/CCE/imaging.

We have additionally shown that as the number of FIT tests performed over a 12-month period increases, the likelihood of having at least one f-Hb ≥ 10 μg/g increases, and conversely the CRC rate fell. Combined with the findings above, this would suggest firstly that patients with a single raised f-Hb ≥ 10 μg/g should be referred and definitively investigated. Secondly, while repeating the FIT once within a 12-month period for patients with persistent or recurrent symptoms provides an additional layer of safety netting, more frequent repeated f-Hb measurements is unhelpful and could lead to unnecessary invasive investigation. A single f-Hb costs the NHS less than £10. If we were to adopt a serial FIT strategy of performing a second FIT within 12 months for those patients with persistent symptoms whose initial f-Hb result was <10 μg/g, the potential cost saving in terms of avoiding unnecessary referral and further, far more expensive diagnostic tests, could be significant.

Interestingly, the overall CRC rate in this cohort of patients (42 of 5761, 0.7%) was lower than that observed in previous studies with similar cohorts of patients with single FIT measurement (1.1%–1.8%) [1, 2, 7, 14, 16]. It may be that patients with persistent unexplained and functional lower GI symptoms are more likely to re-present and undergo serial FIT testing, and that the cohort presented within this study is likely to be different from those described in previous studies of the use of FIT within symptomatic referral pathways.

TABLE 4 Demographics and pathology of 13 patients diagnosed with colorectal whose first faecal haemoglobin result was <10 μg/g

Serial FIT (μg/g)								
First f-Hb	Second f-Hb	Age (years)	Sex	Symptoms	Hb (mg/L)	CRC size (mm)	Primary CRC site	TNM stage
<10	≥10	79	F	Weight loss, anaemia	107	100	Distal transverse	cT4b cN2 cM0
<10	≥10	85	M	Weight loss, anaemia	121	No size	Sigmoid	cT4b cN1 cM0
<10	≥10	51	F	PR bleeding and abdominal pain	147	50	Sigmoid	pT3 pN2a
<10	≥10	82	F	Weight loss, PR bleeding, abdominal pain, anaemia	117	33	Caecum	pT3 pN0
<10	≥10	64	F	Abdominal pain, anaemia	76	50	Ascending colon	pT4b pN1a
<10	≥10	56	F	Weight loss, anaemia	80	No size	Caecum	cTx cN2 cM1.
<10	<10	70	F	Abdominal pain	126	No size	Appendix	cTx cN2 cM1.
<10	<10	67	F	Anaemia	116	40	Transverse	ypT4b ypN0
<10	<10	63	M	Abdominal pain, weight loss, anaemia	115	13	Caecum	cTx cN2 cM1.
<10	≥10	87	M	Anaemia	101	22	Sigmoid	pT1 pN1
<10	≥10	75	M	Anaemia	126	17	Rectum	pT1 pN0
<10	≥10	78	M	Anaemia	95	52	Ascending colon	pT3 pN0
<10	≥10	87	F	Altered bowel habit	129	2	Distal Sigmoid	pT1

Abbreviations: CRC, colorectal cancer; F, female; Hb, haemoglobin; M, male; PR, per rectum.

We have presented the demographics and pathology of the 13 patients diagnosed with CRC whose first f-Hb result was <10 μg/g. It was interesting to note that eight of these patients had tumours proximal to the splenic flexure. FIT has previously been shown to be less sensitive for the detection of such tumours [1]. Ten of these 13 patients were anaemic at the time of the first FIT. Work published previously by the current authors confirmed that combining a single FIT with the presence of anaemia, two objective indicators of CRC risk, was able to reduce the false-negative rate for CRC from 5.2% to 1.7% or less [2, 14]. The false-negative rate of the FIT for CRC is generally reported as 5%–10% [1, 7, 17]. In this study, combining serial FIT with anaemia reduced the false-negative rate for CRC from 7.1% to 2.4%.

While no studies have examined the utility of serial f-Hb measurements over time for detection of CRC, a small number of studies have investigated whether multiple FIT samples taken at the same time may improve diagnostic accuracy. Auge et al. [18] measured f-Hb levels from two consecutive bowel motions in 208 symptomatic patients undergoing colonoscopy. They examined diagnostic yield for advanced colorectal neoplasia (ACRN) using the first of two f-Hb levels ('FIT/1') compared with the maximum f-Hb level measured over two samples ('FIT/max'). With a cut off of 10 μg/g, the sensitivity and specificity of FIT/1 for ACRN was 34.5% and 87.2%, respectively. Similar results could be obtained for FIT/max using a higher cut off of 20 μg Hb/g faeces (sensitivity 34.5% and specificity 85.6%). In a similar study by Matter et al. [19], 280 patients were randomized to a single FIT or two FIT samples in consecutive days prior to undergoing planned colonoscopy. A f-Hb threshold of ≥10 μg Hb/g faeces was used, and patients randomized to two FIT samples who recorded one positive sample and one negative sample were defined as positive. One FIT sample had a sensitivity of 83.3% (95% CI 36.5%–99.1%) and specificity of 86.9% (95% CI 77.3%–92.9%) for CRC detection compared with a sensitivity of 75% (95% CI 35.6%–95.5%) and specificity of 92.9% (95% CI 82.2%–97.7%) for two FIT samples. There was no significant benefit of two FITs over one FIT sampling.

The studies by Miller et al. [20] and Maeda et al. [21] discussed their Covid-19-adapted CRC referral pathway, which utilized two FITs in quick succession combined with a CT with oral contrast. A high f-Hb threshold of 80 μg Hb/g was used. Four hundred and twenty two patients were included. The overall CRC detection rate of 3.1% during utilization of the pathway was similar to that in the period prior to the pandemic (3.3%) [20]. Subsequent analysis revealed that if double FIT testing was used alone at a threshold of 10 μg Hb/g the risk of missing a CRC would be 15.5% [21]. Similar to the studies discussed above, this study examined double FIT measurement within a short time period.

This study has a number of strengths. It is the first study to report the prevalence of serial FIT tests in the symptomatic population and examine the incidence rate of CRC by serial f-Hb result. Our multicentre study reflects real-life practice in Health Boards across Scotland following introduction of the FIT as a tool to guide referral to colorectal and gastroenterology services. Patients with both high-and low-risk symptoms and with and without rectal bleeding were included, reflecting the most up to date evidence and clinical use of the FIT, rather

than the current NICE guidance on FIT use in symptomatic patients [12]. We have carefully considered any potential sources of bias. As we identified study participants by interrogating each Health Board's clinical biochemistry repository, with results automatically uploaded to electronic patient records, we would anticipate a very low number of missed patients. By using cancer registry data, we ensured a low rate of missed CRCs. Our study does, however, have limitations. It is retrospective and observational in nature and hence there is wide variability in the interval between FIT samples. Only patients with serial FITs were included in this study. Patients with persistent symptoms but without repeat FIT measurements were not captured by this study and the results cannot necessarily be extrapolated to this group. However, based on our findings, we would maintain our recommendation that GPs should consider repeat FITs in all patients with persistent symptoms. We do not have access to primary-care records to determine the reasons why patients were subjected to repeat FITs but have assumed this was for persistent/recurrent symptoms. It is possible that a small proportion of patients had a FIT performed in the absence of symptoms, against NICE and local recommendations, for example patients found incidentally to be anaemic or in patients with a strong family history of CRC. We were unable to determine why a proportion of patients with a first f-Hb ≥10 μg/g had a second FIT rather than colonoscopy/CCE/imaging, nor why those patients with anaemia detected at the time of a first f-Hb < 10 μg/g were not referred for investigation at that time, and this will be shared with primary care colleagues in our Boards. Finally, the diagnostic accuracy of serial FITs for other significant bowel diseases, including advanced polyps and inflammatory bowel disease, was outside the scope of this study.

CONCLUSION

This is the first study to examine the prevalence of serial FIT measurements in symptomatic patients and the associated rate of CRC. Serial FIT results account for almost one tenth of all test results and this cohort of patients had a lower prevalence of CRC overall than those cohorts we have described in previous studies [1, 2, 7, 16]. Those patients with two consecutive f-Hb results <10 μg/g in a 12-month period have a very low risk of CRC (0.1%). In contrast, patients with at least one f-Hb result ≥10 μg/g had a higher risk of CRC and should be prioritized for investigation. Performing two FITs within 12 months for patients with persistent symptoms adds an additional layer of safety netting, while performing three or more within the same timeframe is unlikely to be beneficial. Further studies with additional patient numbers should be conducted to validate our findings. Additionally, a formal cost–utility analysis of a serial FIT strategy would help confirm the potential financial benefits.

AUTHOR CONTRIBUTIONS

Data collection: Mark S. Johnstone, Campbell MacLeod, Jayne Digby, Yassir Al-Azzawi, and Grace Pang. *Data analysis*: Mark S. Johnstone, Campbell MacLeod, Jayne Digby, Angus J. M. Watson, Judith Strachan, Craig Mowat, and Stephen T. McSorley. *Edited the manuscript*: Campbell MacLeod, Jayne Digby, Angus J. M. Watson, Judith Strachan, Craig Mowat, and Stephen T. McSorley. *Conceptualisation*: Craig Mowat and Stephen T. McSorley. *Reviewed the literature and wrote the manuscript*: Mark S. Johnstone.

ACKNOWLEDGMENTS

The authors would like to thank Dr Jack Winter, Mr David Mansouri, Mr Paul Witherspoon, Dr Gillian Miller, Dr Emilia Crighton, Mr Paul Burton and Ms Karen Smith. Their contribution to previous work has made this publication possible.

FUNDING INFORMATION

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

CONFLICT OF INTEREST

The authors declare they have no conflicts of interest.

ETHICS APPROVAL

Caldicott Guardian and ethical approvals were in place to safeguard the record linkage in NHS GG&C.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Mark S. Johnstone https://orcid.org/0000-0002-5035-1517
Campbell MacLeod https://orcid.org/0000-0001-9161-0661
Craig Mowat https://orcid.org/0000-0002-5021-415X

REFERENCES

1. McSorley ST, Digby J, Clyde D, Cruickshank N, Burton P, Barker L, et al. Yield of colorectal cancer at colonoscopy according to faecal haemoglobin concentration in symptomatic patients referred from primary care. Colorectal Dis. 2021;23(7):1615–21.
2. Johnstone MS, Burton P, Kourounis G, Winter J, Crighton E, Mansouri D, et al. Combining the quantitative faecal immunochemical test and full blood count reliably rules out colorectal cancer in a symptomatic patient referral pathway. Int J Colorectal Dis. 2022;37(2):457–66.
3. Farrugia A, Widlak M, Evans C, Smith SC, Arasaradnam R. Faecal immunochemical testing (FIT) in symptomatic patients: what are we missing? Frontline Gastroenterol. 2020;11(1):28–33.
4. Khan AA, Klimovskij M, Harshen R. Accuracy of faecal immunochemical testing in patients with symptomatic colorectal cancer. BJS Open. 2020;4(6):1180–8.
5. Westwood M, Lang S, Armstrong N, van Turenhout S, Cubiella J, Stirk L, 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(1):189.
6. Pin Vieito N, Zarraquiños S, Cubiella J. High-risk symptoms and quantitative faecal immunochemical test accuracy: systematic review and meta-analysis. World J Gastroenterol. 2019;25(19):2383–401.

7. Nicholson BD, James T, Paddon M, Justice S, Oke JL, East JE, et al. Faecal immunochemical testing for adults with symptoms of colorectal cancer attending English primary care: a retrospective cohort study of 14 487 consecutive test requests. Aliment Pharmacol Ther. 2020;52(6):1031–41.
8. Ayling RM, Machesney M. Service evaluation of faecal immunochemical testing introduced for use in North East London for patients at low risk of colorectal cancer. J Clin Pathol. 2021;74(3):163–6.
9. Westwood M, Corro Ramos I, Lang S, Luyendijk M, Zaim R, Stirk L, et al. Faecal immunochemical tests to triage patients with lower abdominal symptoms for suspected colorectal cancer referrals in primary care: a systematic review and cost-effectiveness analysis. Health Technol Assess. 2017;21(33):1–234.
10. Mowat C, Digby J, Strachan JA, McCann RK, Carey FA, Fraser CG, et al. Faecal haemoglobin concentration thresholds for reassurance and urgent investigation for colorectal cancer based on a faecal immunochemical test in symptomatic patients in primary care. Ann Clin Biochem. 2021;58(3):211–9.
11. National Insitute for Health and Care Excellence. Suspected cancer: recognition and referral; 2021. NG12. [cited 2021 Apr 9]. Available from: https://www.nice.org.uk/guidance/ng12/chapter/1-Recommendations-organised-by-site-of-cancer#lower-gastrointestinal-tract-cancers
12. National Institute for Health and Care Excellence. Quantitative faecal immunochemical tests to guide referral for colorectal cancer in primary care; 2017. DG30. [cited 2021 Apr 1]. Available from: https://www.nice.org.uk/guidance/dg30/chapter/1-Recommendations
13. Scottish Referral Guidelines for Suspection Cancer. Lower gastrointestinal cancer; 2019 [cited 2021 Apr 9]. Available from: http://www.cancerreferral.scot.nhs.uk/lower-gastrointestinal-cancer/
14. Mowat C, Digby J, Strachan JA, McCann R, Hall C, Heather D, et al. Impact of introducing a faecal immunochemical test (FIT) for haemoglobin into primary care on the outcome of patients with new bowel symptoms: a prospective cohort study. BMJ Open Gastroenterol. 2019;6(1):e000293.
15. WHO. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and mineral nutritional information system; 2011. World Health Organisation, Geneva (WHO/NMH/NHD/MNM/111).
16. Chapman C, Thomas C, Morling J, Tangri A, Oliver S, Simpson JA, et al. Early clinical outcomes of a rapid colorectal cancer diagnosis pathway using faecal immunochemical testing in Nottingham. Colorectal Dis. 2020;22(6):679–88.
17. D'Souza N, Georgiou Delisle T, Chen M, Benton S, Abulafi M. 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(6):1130–8.
18. Auge JM, Fraser CG, Rodriguez C, Roset A, Lopez-Ceron M, Grau J, et al. Clinical utility of one versus two faecal immunochemical test samples in the detection of advanced colorectal neoplasia in symptomatic patients. Clin Chem Lab Med. 2016;54(1):125–32.
19. Mattar R, Marques SB, Minata MK, Silva-Etto J, Sakai P, De Moura EGH. Diagnostic accuracy of one sample or two samples quantitative fecal immunochemical tests for intestinal neoplasia detection. Arq Gastroenterol. 2020;57(3):316–22.
20. Miller J, Maeda Y, Au S, Gunn F, Porteous L, Pattenden R, et al. Short-term outcomes of a COVID-adapted triage pathway for colorectal cancer detection. Colorectal Dis. 2021;23(7):1639–48.
21. Maeda Y, Gray E, Figueroa JD, Hall PS, Weller D, Dunlop MG, et al. Risk of missing colorectal cancer with a COVID-adapted diagnostic pathway using quantitative faecal immunochemical testing. BJS Open. 2021;5(4):zrab056.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Johnstone MS, MacLeod C, Digby J, Al-Azzawi Y, Pang G, Watson AJM, Prevalence of repeat faecal immunochemical testing in symptomatic patients attending primary care. Colorectal Dis. 2022;24:1498–1504. https://doi.org/10.1111/codi.16240