

Working up rectal bleeding in adult primary care practices

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Abstract

Rationale, aims and objectives Variation in the workup of rectal bleeding may result in guideline-discordant care and delayed diagnosis of colorectal cancer. Accordingly, we undertook this study to characterize primary care clinicians' initial rectal bleeding evaluation.

Methods We studied 438 patients at 10 adult primary care practices affiliated with three Boston, Massachusetts, academic medical centres and a multispecialty group practice, performing medical record reviews of subjects with visit codes for rectal bleeding, haemorrhoids or bloody stool. Nurse reviewers abstracted patients' sociodemographic characteristics, rectal bleeding-related symptoms and components of the rectal bleeding workup. Bivariate and multivariable logistic regression models examined factors associated with guideline-discordant workups.

Results Clinicians documented a family history of colorectal cancer or polyps at the index visit in 27% of cases and failed to document an abdominal or rectal examination in 21% and 29%. Failure to order imaging or a diagnostic procedure occurred in 32% of cases and was the only component of the workup associated with guideline-discordant care, which occurred in 27% of cases. Compared with patients at hospital-based teaching sites, patients at urban clinics or community health centres had 2.9 (95% confidence interval 1.3–6.3) times the odds of having had an incomplete workup. Network affiliation was also associated with guideline concordance.

Conclusion Workup of rectal bleeding was inconsistent, incomplete and discordant with guidelines in one-quarter of cases. Research and improvements strategies are needed to understand and manage practice and provider variation.

Primary care clinicians are often asked to assess the clinical significance of common complaints. Rectal bleeding is a case in point, requiring clinicians to distinguish bleeding attributable to conditions such as internal haemorrhoids from more ominous diseases like colorectal cancer. Twelve to fifteen per cent of patients report seeing blood on the toilet paper in the previous six months [1]. In addition to the bleeding history and examination findings, clinicians' evaluation of rectal bleeding may be informed by attributes that affect the prior probability of malignant disease, including the patient's age, race, family history and prior screening or diagnostic studies. And although professional

practice guidelines outline the elements of a recommended evaluation [2], few take into account the subtlety or complexity of cases that present themselves to frontline practitioners. This leads to variation in practice, guideline-discordant care and delayed diagnosis [1–5].

In order to understand variation in the workup of rectal bleeding, we undertook a secondary analysis of a medical record review study of patients over 40 years of age with rectal bleeding cared for at 10 Boston adult primary care practices [6]. The present study seeks to characterize primary care providers' initial evaluation of rectal bleeding and the degree to which variation

in the workup of rectal bleeding accounted for differences in practice guideline concordance. We hypothesized that the workup of rectal bleeding and guideline concordance would vary substantially by practice site.

Methods

Setting

We studied 10 adult primary care practices associated with three Harvard-affiliated Boston academic medical centres and a large multispecialty group practice. Each of the three medical centres had an onsite primary care teaching practice. The community practices were selected using a computer-generated random number from among the practices associated with each medical centre or the multispecialty group practice. Four of the community-based practices were urban and three were suburban. All sites associated with a given medical centre or group practice shared a common electronic medical record.

Subjects

Subjects were adult primary care patients who were seen in their primary care practice from 1 July 2006 to 30 June 2008 with a new episode of rectal bleeding. Potential subjects were identified using administrative records generated for each site based on age over 40 years and presence of the following International Classification of Diseases, Clinical Modification (ICD-9-CM) codes 569.3 (rectal bleeding), 578.1 (blood in the stool) and 455.0, 455.1, 455.2 or 455.3 (haemorrhoids).

Measurements

The research team, composed of primary care doctors, gastroenterologists, nurses and health services researchers, created a chart abstraction instrument based on a tool used to examine the quality of breast cancer care in a primary care population [7]. The instrument elicited information including age, race, ethnicity, gender, primary language, insurance, home zip code and medical co-morbidities. It also elicited information about rectal bleeding-related symptoms, medical history, physical examination and findings, diagnostic tests, specialty referrals and communication of test results. After piloting a paper form of the tool for usability, the instrument was converted into an online data entry and storage format using Datstat (Illume, Seattle, WA, USA).

Investigators trained nurse reviewers in record abstraction and data entry using practice cases. The chart review entailed examination of the electronic ambulatory medical record at each site during a 3-month period following an initial primary care visit for rectal bleeding (the 'index' visit). Nurse reviewers checked the note from the index visit to confirm that the patient was not undergoing an evaluation for a recent episode of rectal bleeding. We excluded patients if rectal bleeding was identified in an emergency department immediately prior to the index visit or if patients had ulcerative colitis, Crohn's disease or a history of colorectal cancer based on a 3-year retrospective review of problem lists, progress and consult notes, and discharge summaries.

The research team met regularly to review data collection and ensure consistent abstraction practices across study sites. Two doctor-investigators next reviewed each nurse abstraction to confirm study eligibility and to classify the adequacy of the workup and overall quality of care. The nurse abstractions were performed from 5 January 2010 to 6 April 2011, to allow for complete follow-up and ascertainment of pathology results, with doctor review from 26 January 2010 to 26 October 2012.

Of 740 patients with an ICD-9 code for rectal bleeding, 480 were found to be eligible on initial review after excluding cases with prior bleeding, known colorectal cancer or inflammatory bowel disease. Forty-two additional cases were excluded based on doctor review of the nurse abstraction, yielding a final cohort of 438 subjects.

Analyses

We tabulated the sociodemographic and clinical characteristics of the cohort and clinicians' workup of rectal bleeding. Based on medical record documentation, we calculated the number and per cent of cases in which the clinician at the index visit elicited a history of present illness and family history of colorectal cancer or polyps; performed a physical examination; ordered laboratory, imaging or diagnostic procedures; noted a presumptive diagnosis; discussed rectal bleeding with the patient; or documented a follow-up plan. We tabulated the number and per cent of cases where a finding or abnormality was identified. Zip codes were used as proxy for income based on US Census data and divided into low (0–49th percentile), medium (50–74th) and high (>75th) income categories.

Guideline concordance was based on the Harvard Risk Management Foundation's 2006 *Colon Cancer Screening and Diagnosis Guidelines* [8], an evidence-based algorithm widely distributed to study practices [6–17]. The *Guidelines* for rectal bleeding called for a colonoscopy among patients ≥ 50 years old with rectal bleeding and no colonoscopy in the previous two years, and among patients 40–49 years old with a family history of colon cancer or colonic adenomas. The *Guidelines* recommended at least a flexible sigmoidoscopy for patients with rectal bleeding age ≥ 50 years with a colonoscopy in the previous two years and for those aged 40–49 years without a family history.

We classified care as delayed if an interval of more than 90 days elapsed from index visit to completion of a procedure to visualize the colon in accordance with the *Guidelines*. Patients who had completed a colonoscopy with adequate preparation within two years were not considered guideline concordant.

We examined the association of patients' sociodemographic, clinical characteristics and practice setting with the odds of having a guideline-concordant workup in bivariate analyses using the chi-square statistic for categorical data and the Wilcoxon rank-sum test for continuous data. We created bivariate and multivariable logistic regression models using backward elimination ($P \leq 0.2$) and two-tailed tests of significance ($P \leq 0.05$). We repeated this approach to examine whether components of the rectal bleeding workup at the index visit were associated with guideline-concordant care, controlling for sociodemographic, clinical and practice factors that were statistically significant in the initial model. We performed a parallel analysis to examine whether

positive findings during the workup of rectal bleeding were associated with guideline-concordant care. Analyses used STATA 9 (StataCorp, College Station, TX, USA). The study was approved in advance by the Dana-Farber/Harvard Cancer Center institutional review board.

Results

Patient characteristics

Characteristics of the study cohort are displayed in Table 1. The mean age was 56 years, 19% were non-White, 10% were Hispanic and 8% required an interpreter during clinic visits. Subjects' neighbourhood income was below the US mean in 26% of cases, and 16% had Medicaid insurance or were self-insured. Fourteen per cent had a family history of colorectal cancer or colon polyps, 32% had a prior history of any rectal bleeding and 55% had previously completed colorectal cancer screening. The cohort was distributed among hospital-based, urban and suburban practice sites.

Workup of rectal bleeding

Table 2 displays the workup of rectal bleeding at the index visit and the presence of abnormal findings. Clinicians elicited and documented information about the patient's present history of rectal bleeding in 96% of cases. Altered bowel habits was the most commonly reported symptom. Clinicians documented a positive or negative family history of colon cancer or polyps in the index visit progress note in only 27% of patients, with about one-third of these subjects reporting a positive family history. Clinicians documented the blood pressure routinely but reported abdominal and rectal examinations in only 79% and 71% of cases, respectively. Positive findings were present in a minority of cases. Although clinicians ordered blood counts (haemoglobin, haematocrit or complete blood count) for every patient, less than 2% were abnormal. Clinicians ordered imaging or diagnostic procedures in about two-thirds of cases, including referrals to a gastroenterologist for consultation or colonoscopy in 50% of cases. Clinicians documented a presumptive diagnosis in their note in two-thirds of cases, with haemorrhoids identified most often. Clinicians documented a discussion of rectal bleeding with the patient and a follow-up plan in most cases. Six colon cancers were detected among patients in this cohort.

Factors associated with guideline-discordant care

Overall, 117 (27%) of 438 patients with rectal bleeding failed to receive guideline-concordant care within 90 days of the index visit. Guideline concordance, stratified by subjects' sociodemographic, clinical and practice characteristics, is shown in Table 3.

Practice type and network affiliation were the only factors associated with a guideline-discordant workup in bivariate analyses. In the multivariable model, a personal history of prior colorectal cancer screening increased the odds of an incomplete workup by 1.6 (95% confidence interval 1.0–2.7). Compared with patients seen

Table 1 Subjects' social, demographic, clinical and practice characteristics, *N* = 438

Characteristic	
Age, mean (range), SD	56.4 (40–93), 12.1
Male, <i>n</i> (%)	188 (42.9)
Race, <i>n</i> (%)	
White	278 (63.5)
African American	62 (14.2)
Asian	20 (4.6)
American Indian or Alaska native	1 (0.2)
Unknown	77 (17.6)
Ethnicity, <i>n</i> (%)	
Hispanic	43 (9.8)
Non-Hispanic	376 (85.8)
Unknown	19 (4.3)
Interpreter required, <i>n</i> (%)	36 (8.2)
Lived alone, <i>n</i> (%)	80 (18.3)
Neighbourhood income vs. US mean, <i>n</i> (%)	
<50%	115 (26.3)
50–74%	86 (19.6)
>74%	237 (54.1)
Insurance, <i>n</i> (%)	
Private	241 (55.0)
Medicare	119 (27.2)
Medicaid or self-pay	72 (16.4)
Federal	2 (0.5)
Unknown	4 (0.9)
Charlson index, mean (range), SD	0.6 (0–8), 1.1
Number of medications, mean (range), SD	4.9 (0–26), 4.3
Family history of colorectal cancer or colon polyps in first-degree relatives, <i>n</i> (%)	61 (13.9)
Personal history of rectal bleeding in previous 3 years, <i>n</i> (%)	139 (31.7)
Personal history of any prior colon cancer screening,* <i>n</i> (%)	267 (54.6)
Practice type, <i>n</i> (%)	
Hospital-based teaching site	163 (37.2)
Urban practice or community health centre	142 (32.4)
Suburban practice	133 (30.4)
Network, <i>n</i> (%)	
A	65 (14.8)
B	185 (42.2)
C	79 (18.0)
D	109 (24.9)
Identified nurse practitioner, <i>n</i> (%)	40 (9.1)

*Prior screening tests included colonoscopy (*n* = 237), stool occult blood (*n* = 92), flexible sigmoidoscopy (*n* = 67), barium enema (*n* = 7) or virtual colonoscopy (*n* = 3).

SD, standard deviation.

at hospital-based teaching sites, those seen at urban clinics or community health centres were 2.9 (1.3–6.3) times as likely to have had an incomplete workup after controlling for other covariates. Network affiliation also was associated with guideline concordance. Patients in Network C had an increased odds (2.2, 1.0–4.9), and those in network D a decreased odds (0.1, 0.0–0.4) of an incomplete workup.

Given the prominence of practice type and network affiliation on the workup of rectal bleeding, we examined guideline-discordance

Table 2 Workup of rectal bleeding at the index visit and findings, *N* = 438

	Assessment performed <i>n/N</i> , %	Abnormality or finding present <i>n/N</i> , %
History of present illness elicited		
Any history elicited	420/438, 95.9	299/420, 71.2
Bowel habits (i.e. bleeding, easy, hard, normal stool and straining)	326/438, 74.4	207/326, 63.5
Diarrhoea	284/438, 64.8	57/284, 20.1
Rectal pain	307/438, 70.1	80/307, 26.1
Abdominal pain	336/438, 76.7	50/336, 14.9
Other associated symptoms (i.e. chills, fever, loss of appetite, weight loss and other)	343/438, 78.3	70/343, 20.4
Family history of colon cancer or polyps elicited	116/438, 26.5	35/116, 30.2
Physical examination performed		
Blood pressure taken (abnormal if systolic blood pressure < 100 mm)	395/438, 90.2	8/395, 2.0
Abdominal examination (abnormal if pain, tenderness, distension, hepatomegaly, or other finding was present)	347/438, 79.2	35/347, 10.1
Rectal examination	310/438, 70.8	53/310, 17.1
Faecal occult blood test	228/438, 52.1	80/228, 35.1
Vaginal examination (women only)	40/250, 16.0	0/40, 0
Laboratory testing performed		
Any blood tests (i.e. haemoglobin, haematocrit, INR or iron studies)	438/438, 100.0	8/438, 1.8
Haemoglobin or haematocrit	438/438, 100.0	4/438, 0.9
INR	12/438, 2.7	0/12, 0
Iron studies (i.e. iron, ferritin or total iron binding capacity)	25/438, 5.7	5/25, 20.0
Imaging or diagnostic procedure ordered/not completed*	298/438, 68.0	58/298, 19.5
Presumptive diagnosis noted†	288/438, 65.8	<i>n/a</i>
Rectal bleeding discussed with patient	415/438, 94.7	<i>n/a</i>
Follow-up plan documented	372/438, 84.9	<i>n/a</i>

*Completed imaging procedures included colonoscopy (*n* = 218), upper endoscopy (*n* = 14), flexible sigmoidoscopy (*n* = 9), abdominal computed tomography scan (*n* = 8), anoscopy (*n* = 7), barium enema (*n* = 1) or virtual colonoscopy (*n* = 1).

†Presumptive diagnoses at the initial visit included haemorrhoids (*n* = 205), colon polyp (*n* = 22), anal fissure (*n* = 21), colon cancer (*n* = 14), diverticulosis (*n* = 19), arterial-venous malformation (*n* = 9), infectious colitis (*n* = 3), ulcerative colitis (*n* = 3), anal fistula (*n* = 1), Crohn's disease (*n* = 2) and other diagnosis (*n* = 70); totals may exceed 100% because clinicians may have identified multiple diagnoses in a given case.

SD, standard deviation; INR, international normalized ratio; *n/a*, not applicable.

Table 3 Subjects' social, demographic, clinical and practice characteristics and their association with guideline-discordant workup for rectal bleeding within 90 days, *N* = 438

Characteristic, %	Concordant care (<i>n</i> = 321)	Discordant care (<i>n</i> = 117)	<i>P</i> -value	Bivariate (unadjusted) OR (95% CI)	Multivariable (adjusted*) OR (95% CI)
Age, mean (range), SD	56.3 (40–93), 12.0	56.2 (40–88), 12.3	0.97 rs	1.000 (0.983–1.018)	—
Male gender	43.9	40.2	0.48 chi	0.857 (0.557–1.318)	—
Non-White race	22.6	24.2	0.74 chi	1.097 (0.632–1.901)	—
Hispanic	11.4	7.2	0.22 chi	0.606 (0.272–1.349)	—
Interpreter required	8.4	7.7	0.81 chi	0.907 (0.413–1.991)	—
Lived alone	17.8	19.7	0.65 chi	1.133 (0.661–1.941)	—
Neighbourhood income vs. US mean			0.93 chi		
<50%	26.5	25.6	—	Ref	—
50–74%	19.9	18.8	—	0.974 (0.514–1.844)	—
>74%	53.6	55.6	—	1.071 (0.646–1.774)	—
Medicaid or self-insured	5.6	8.6	0.27 chi	1.573 (0.704–3.515)	—
Charlson index, mean (range), SD	0.6 (0–6), 1.1	0.7 (0–8), 1.3	0.36 rs	1.064 (0.890–1.272)	—
Number of medications, mean (range), SD	4.9 (0–19), 4.1	5.3 (0–26), 5.1	0.97 rs	1.017 (0.970–1.068)	—
Family history of colorectal cancer or colon polyps	41.5	10.6	0.14 chi	0.624 (0.335–1.163)	0.792 (0.418–1.500)
Personal history of rectal bleeding in the previous 3 years	68.3	31.7	0.46 chi	0.993 (0.630–1.565)	—
Personal history of prior colon cancer screening	44.3	55.7	0.16 chi	1.340 (0.893–2.010)	1.569 (1.044–2.729)
Practice type			0.001 chi		
Hospital-based teaching site	41.4	25.6	—	Ref	Ref
Urban practice or community health centre	32.7	31.6	—	2.892 (1.243–6.725)	2.913 (1.340–6.335)
Suburban practice	25.9	42.7	—	1.836 (0.972–3.466)	1.744 (0.976–3.146)
Network			<0.001 chi		
A	15.6	12.8	—	Ref	Ref
B	40.8	46.2	—	1.252 (0.558–2.811)	1.540 (0.763–3.108)
C	11.8	35.0	—	2.756 (1.131–6.712)	2.188 (0.969–4.941)
D	31.8	6.0	—	0.110 (0.037–0.331)	0.135 (0.048–0.381)
Identified nurse practitioner	9.7	7.7	0.53 chi	0.779 (0.359–1.691)	—

*Step-wise logistic regression with backward elimination ($P \leq 0.2$).

OR, odds ratio; CI, confidence interval; chi, chi-square statistic; rs, rank-sum test.

by practice, as shown in the Fig. 1. Performance varied markedly from site to site within each network, although discordant care and practice variation were notably less prominent in network D compared with the others.

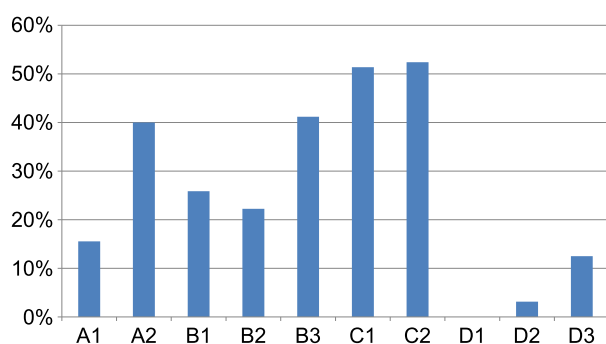


Figure 1 Per cent of subjects with guideline-discordant workup of rectal bleeding within 90 days, by network (A, B, C and D) and practice site.

Controlling for the sociodemographic, clinical and practice factors associated with guideline-discordant workup, we examined whether components of the clinicians' workup at the index visit were associated with guideline-discordant care. As shown in Table 4, ordering of an imaging or diagnostic procedure and documentation of a follow-up plan were the only factors associated with reduced odds of a guideline-discordant workup in bivariate analyses. In the multivariable analysis, ordering an imaging or diagnostic test was the only factor with decreased odds of guideline-discordant care (0.4, 0.2–0.6). In a parallel analysis examining the relationship between positive findings at the index visit and guideline concordance, failure to complete imaging or diagnostic testing increased the odds of guideline-discordant care by 5.9 (3.5–9.9).

Discussion

We found significant variation in the workup of rectal bleeding in this retrospective record review of 438 patients cared for at 10 Boston adult primary care practices, including worrisome lapses.

Table 4 Workup of rectal bleeding at the index visit and its association with guideline-discordant workup for rectal bleeding within 90 days, *N* = 438

	Concordant care (<i>n</i> = 321), %	Discordant care (<i>n</i> = 117), %	<i>P</i> -value	Bivariate (unadjusted) OR (95% CI)	Multivariable (adjusted*) OR (95% CI) Finding elicited	Multivariable (adjusted*) OR (95% CI) Finding present
Any history of present illness [†]						
Elicited	73.3	26.7	0.92 chi	0.945 (0.330–2.712)	9.90 (1.027–95.451)	
Positive	75.9	24.1	0.07 chi	0.662 (0.425–1.032)		0.684 (0.421–1.111)
Family history of colon cancer or polyps						
Elicited	75.0	25.0	0.63 chi	0.886 (0.545–1.442)	1.393 (0.828–2.341)	
Positive	77.1	22.9	0.59 chi	0.799 (0.352–1.813)		—
Blood pressure						
Taken	72.2	27.9	0.10 chi	1.985 (0.858–4.593)	—	
Abnormal	62.5	37.5	0.49 chi	1.663 (0.391–7.071)		3.979 (0.695–22.768)
Abdominal examination						
Performed	73.2	26.8	0.94 chi	1.022 (0.606–1.724)	0.550 (0.237–1.273)	
Abnormal	82.9	17.1	0.18 chi	0.544 (0.220–1.346)		—
Rectal examination						
Performed	71.6	28.4	0.22 chi	1.353 (0.836–2.191)	—	—
Abnormal	66.7	33.3	0.24 chi	1.439 (0.782–2.650)		—
Faecal occult blood test						
Performed	70.6	29.4	0.19 chi	1.332 (0.869–2.040)	1.754 (0.894–3.440)	
Positive	72.5	27.5	0.86 chi	1.050 (0.610–1.809)		1.491 (0.910–2.443)
Vaginal examination performed (women only, <i>n</i> = 281)	70.0	30.0	0.76 chi	1.123 (0.535–2.356)	n/a	n/a
Laboratory testing						
Any blood test performed [‡]	100.0	100.0	n/a	n/a	n/a	
Abnormal	50.0	50.0	0.13 chi	2.805 (0.690–11.404)		3.979 (0.695–22.77)
Imaging or diagnostic procedure						
Any test ordered	80.2	19.8	<0.001 chi	0.349 (0.225–0.542)	0.352 (0.200–0.618)	
Testing not completed	58.1	41.9	<0.001 chi	4.373 (2.761–6.925)		5.863 (3.462–9.928)
Presumptive diagnosis noted	74.0	26.0	0.66 chi	0.905 (0.581–1.411)	—	n/a
Rectal bleeding discussed with patient	73.3	26.8	0.94 chi	1.035 (0.398–2.690)	—	n/a
Follow-up plan documented	76.3	23.7	0.001 chi	0.395 (0.230–0.680)	0.580 (0.292–1.154)	n/a

*Step-wise logistic regression with backward elimination ($P \leq 0.2$), controlling for social, demographic, clinical and practice factors included in the multivariable model in Table 3.[†]Assessments included bowel habits, diarrhoea, rectal pain, abdominal pain or other specified symptoms as listed in Table 2.[‡]Blood tests included haemoglobin, haematocrit, complete blood count, international normalized ratio, iron, ferritin and total iron binding capacity as listed in Table 2.

OR, odds ratio; CI, confidence interval; chi, chi-square statistic.

Clinicians working up symptoms of rectal bleeding rarely documented that a family history of colorectal cancer or polyps was performed at the index visit, and many failed to describe an abdominal or rectal examination. Clinicians ordered blood counts and haemoglobin levels routinely but rarely found evidence of anaemia. Although most clinicians documented a discussion of the findings with the patient and a follow-up plan, they failed to specify a presumptive or differential diagnosis one-third of the time. No order for additional diagnostic testing such as flexible sigmoidoscopy or colonoscopy was made in 32% of cases. Failure to order additional testing or imaging occurred in about one in four cases. It was the only component of the workup that was associated reliably with guideline-discordant care in the multivariable analysis, as the guideline explicitly required timely diagnostic testing or imaging.

Variation in care is a well-known phenomenon in health care, often seen when the evidence base for best practice is thin [9–11]. In the absence of consensus about appropriate care, clinicians rely on their own judgement and experience and benchmark their practice against colleagues and peers. Practice guidelines can reduce variation and improve standardization, but dissemination and implementation of guidelines are challenging and often protracted [12–14]. Colorectal cancer screening guidelines are a case in point. In regional and national practitioner surveys conducted over the past decade, primary care doctors' knowledge of colorectal cancer screening guidelines was inconsistent [15–18]. Studies have demonstrated knowledge and performance deficits with respect to colorectal cancer screening, with variation in performance associated with factors such as patient age, co-morbid illness and provider specialty [19,20].

Organizational factors played a prominent role in this study, with marked variation in the workup of rectal bleeding and guideline concordance across practices, practice types and networks. This finding mirrors research showing the importance of practice-related influence in colorectal cancer screening and in surveillance colonoscopy for colorectal cancer survivors [21]. For example, a survey of 984 Arizona primary care doctors showed significantly lower rates of self-reported colorectal screening guideline compliance among solo, group and community health centre-based clinicians compared with those in academic practice [18]. Similarly, a study of 38 818 patients at 155 Veterans Administration clinics showed an association of colorectal cancer screening rates with the operational characteristics of the clinic, such as control over care processes, smaller size and support resources [22]. Electronic health records can improve the likelihood of guideline compliance with colorectal cancer screening but may not overcome persistent patterns of interpractice variation [23].

Unfortunately, we have little evidence to explain why certain practices in this study performed so much better than others. All sites used electronic medical records, although the utility and usability of the systems may differ. Urban practices and community health centres may lack resources available to other practice types. The multivariable models controlled for multiple potential confounders, suggesting that unmeasured factors such as clinic protocols, operational standards, information technology and practitioner alignment may have produced more practice discipline at some sites than others. It is possible that certain practices were

better resourced than others in terms of staffing or performance improvement expertise, or that the organizational culture of the organization or practice affected the collective performance of that unit. In fact, these factors are likely more important than individual doctor performance and documentation. A similar phenomenon has been reported across cancer centres, where disease management decisions across institutions reflected local and historical approaches to common clinical scenarios [11]. In addition, patients' willingness or inability to comply with clinicians' recommendations may play a prominent role.

While rectal bleeding is a familiar complaint facing primary care clinicians, its evaluation may be quite challenging and nuanced. Of the patients in our study, one in seven had a family history of colorectal cancer or colon polyps, one-third had a personal history of recent rectal bleeding and more than half had previously undergone colon cancer screening. This complexity is not readily incorporated into practice guidelines. Primary care doctors may question the relevance of a practice guideline that calls for repeated colonoscopy in a patient with persistent bleeding and multiple prior negative workups [24].

At the same time, failure to identify a serious illness represents a potentially serious diagnostic error. Previous investigators have reported that alarm symptoms are often unrecognized among patients ultimately diagnosed with colorectal cancer, implying that clinicians could have identified and referred such cases earlier for testing and treatment. Missed and delayed colorectal cancer diagnoses are a large and growing source of malpractice liability claims [25]. Increased prominence of these claims reflects a variety of factors including patients' rising expectations for early detection. It belies the burden of morbidity and early mortality for patients with delayed colorectal cancer diagnoses, financial consequences and emotional impact for patients and families, and risk to the relationship between patients and their health providers.

Improving the care of patients with rectal bleeding requires practitioners to adopt a disciplined approach to the evaluation of worrisome clinical signs. Although clinician education is a no-regret strategy, initiatives are more likely to succeed if they address practice infrastructure. For example, practices should facilitate access to diagnostic algorithms for rectal bleeding and embed decision support in electronic health records. Templated notes may prompt clinicians to perform a thorough assessment and ensure complete documentation of symptoms and signs, family history, examination findings and differential diagnosis. Standard order sets may simplify laboratory testing and facilitate referrals for endoscopic imaging. However, successful adoption of innovations requires buy-in from practitioners and their staffs. Without a culture that values reliability as a mechanism for reducing variability and improving quality, efforts to standardize care may become 'tick-box' exercises that add little value [26,27].

This study was limited by the use of retrospective medical record review, a process that requires consistent data abstraction and is dependent upon the quality of documentation. We attempted to overcome this limitation by using well-trained nurse reviewers and a standardized online data collection tool. The study was not powered to assess the impact of lapses on clinical outcomes such as cancer-specific mortality or stage at diagnosis. However, our outcome measure required timely completion of the evaluation. Delays are a patient-centred outcome that may correlate with

unnecessary emotional distress. In addition, the study's generalizability may be limited by the selection of Boston practices affiliated with large health care systems. The clinical care in these organizations may be more consistent than care delivered in other communities, in turn, underestimating the degree of variation of care present elsewhere. Finally, the findings may be limited by the time interval that has elapsed since the care was rendered. While practice changes at the study sites may have occurred since the data were collected, the CRICO *Guidelines* for workup of rectal bleeding have undergone only one minor modification: colonoscopy is now recommended as an alternative to flexible sigmoidoscopy for rectal bleeders over age 50 years whose last colonoscopy occurred more than two years earlier [28].

In summary, rectal bleeding is a common complaint in primary care and one that must be evaluated carefully to rule out polyps, cancer or other serious conditions. Frontline clinicians' task may be complicated by the prevalence of this complaint in primary care practice and in the same patient, common benign alternative diagnoses such as internal haemorrhoids and physicians' reluctance to recommend an invasive diagnostic test such as colonoscopy. Given the potential malpractice liability associated with missed colorectal cancer diagnoses, clinicians are advised to complete and document a thorough initial assessment including a family history of gastrointestinal polyps or cancer, abdominal and rectal examinations and presumptive diagnoses. Referral for definitive testing is the single, critical component of the workup associated with guideline-concordant care. Additional investigation is necessary to understand why certain practices or practice networks are more likely than others to provide consistent guideline-concordant care.

Conflict interests

The authors declare no conflict of interest. This paper was not previously presented.

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Author contributions

Conception or design was performed by Weingart, Stoffel, Chung, Sequist, Lederman, Pelletier and Shields. Acquisition, analysis or interpretation of data was carried out by Weingart, Stoffel, Chung, Sequist, Lederman, Pelletier and Shields. Weingart drafted the manuscript. Critical revision of the manuscript was performed by Stoffel, Chung, Sequist, Lederman, Pelletier and Shields. Statistical analysis was carried out by Weingart and Pelletier. Weingart and Shields obtained funding for this study. Administrative,

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