Shortened surveillance intervals following suboptimal bowel preparation for colonoscopy: Results of a national survey

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Abstract

Purpose—Suboptimal bowel preparation can result in decreased neoplasia detection, shortened surveillance intervals, and increased costs. We assessed bowel preparation recommendations and the relationship to self-reported proportion of suboptimal bowel preparations in practice; and evaluated the impact of suboptimal bowel preparation on colonoscopy surveillance practices. A random sample of a national organization of gastroenterologists in the U.S. was surveyed.

Methods—Demographic and practice characteristics, bowel preparation regimens, and proportion of suboptimal bowel preparations in practice were ascertained. Recommended follow-

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Conflict of interests None.

up colonoscopy intervals were evaluated for optimal and suboptimal bowel preparation and select clinical scenarios.

Results—We identified 6,777 physicians, of which 1,354 were randomly selected; 999 were eligible, and 288 completed the survey. Higher proportion of suboptimal bowel preparations/week (10 %) was associated with hospital/university practice, teaching hospital affiliation, >25 % Medicaid insured patients, recommendation of PEG alone and sulfate-free. Those reporting >25 % Medicare and privately insured patients, split dose recommendation, and use of MoviPrep® were associated with a <10 % suboptimal bowel preparations/week. Shorter surveillance intervals for three clinical scenarios were reported for suboptimal preparations and were shortest among participants in the Northeast who more often recommended early follow-up for normal findings and small adenomas. Those who recommended 4-l PEG alone more often advised <1 year surveillance interval for a large adenoma.

Conclusions—Our study demonstrates significantly shortened surveillance interval recommendations for suboptimal bowel preparation and that these interval recommendations vary regionally in the United States. Findings suggest an interrelationship between dietary restriction, purgative type, and practice and patient characteristics that warrant additional research.

Introduction

Colorectal cancer is the third leading cause of cancer and cancer-related death in the United States [1]. Early detection and removal of precancerous polyps through screening has contributed to the steady decline in colorectal cancer incidence and mortality in recent years [1]. While there exist multiple modalities by which individuals can be screened for colorectal cancer, guidelines issued by multiple agencies consider colonoscopy as a preferred screening modality [2, 3]. As a result of increased colorectal cancer screening and detection of polyps, the demand for follow-up surveillance has also increased and now has become the most common reason for colonoscopy among adults aged 50 years and older in this country [4]. In fact, it is estimated that 25 % of all colonoscopies in the United States are for surveillance of polyps [5].

Bowel preparation is critical as diagnostic accuracy of the colonoscopy is dependent upon the ability to visualize the colon. However, reports indicate that, in as many as 19–30 % of colonoscopies [6–9], bowel preparation is suboptimal. Consequently, the endoscopist's ability to reach the cecum is compromised, adenoma detection rate is lowered, the duration of the procedure is increased, and neoplasia may be missed [10].

Surveillance interval recommendations are dependent upon the number and pathology of the polyp(s) found which reflect the risk for future advanced adenomas (10 mm or villous features or 3 adenomas) and colorectal cancer [11, 12]. Guidelines indicate that follow-up of an index colonoscopy for findings within normal limits for an average-risk person is 10 years based on the rate at which advanced adenomas develop and the sensitivity of the colonoscopy [11]. Due to concern regarding inadequate inspection, suboptimal bowel preparation quality increases the duration of the colonoscopy and results in more repeat colonoscopies at shortened intervals which can drive up the cost of colonoscopy by as much as 12–22 % [9, 13, 14]. Shorter follow-up intervals also compromise system capacity to provide screening colonoscopy, and subject patients to further inconvenience and potentially expose them to greater risk of perforation and other adverse events [15–17].

In this study conducted among a nationally representative random cohort of American College of Gastroenterology (ACG) physicians, we sought to assess bowel preparation recommendations and the relationship to self-reported proportion of suboptimal bowel preparations in practice. Additionally, we examined the intervals at which these physicians recommend surveillance colonoscopy after suboptimal bowel preparation for six clinical scenarios and examined characteristics of those recommending shortened surveillance intervals for suboptimal bowel preparations. We hypothesized that factors related to the physician, the practice, the setting and the patient contribute to suboptimal bowel preparation and that interval recommendations will vary across the country. Only two studies to date have evaluated surveillance practices following suboptimal bowel preparation [13, 18] and no other studies have evaluated bowel preparation recommendations within the context of suboptimal bowel preparation quality.

Methods

This study was conducted between September 2010 and March 2011. With permission from the Research Committee of the American College of Gastroenterology in the United States, we obtained a complete U.S. membership list (n=10,228) consisting of names, credentials, and email and street addresses. Those members affiliated with pharmaceutical companies or non-medical entities, who had non-medical credentials (e.g., Ph.D.), or practiced pediatric gastroenterology were excluded (n=3,451). Of the remaining 6,777 members, we randomly selected a 20 % sample (n=1,355) using the random sample generator function of IBM SPSS version 19.

Three members (two previously responded in a pilot test of the study instrument and one duplicate entry) were removed post-selection of the random sample, resulting in 1352 physicians in our study sample. Of these, 26.2 % (n=354) were ineligible for the following reasons: unable to locate or had left the country (n=33), deceased (n=4), retired (n=27), and did not meet eligibility criteria (n=290, not a gastroenterologist, served a pediatric patient population, and did not perform screening colonoscopy routinely). Of 999 eligible participants, 288 (28.8 %) responded.

Each of the selected physicians was sent a personalized introductory letter stating an endorsement by the ACG to conduct this study, and a private link to an online survey over secure internet lines using Qualtrics™. A maximum of three emails were sent at approximately one month intervals, followed by two postal mailings approximately one month apart. Between email surveys and the postal surveys, each member was contacted by telephone to confirm the mailing address and eligibility. Completion of the survey was also encouraged during this call. A small incentive valued at $10 was offered to enhance participation.

The survey was developed and pilot-tested among gastroenterology fellows and faculty at our institution. Questions were grouped into four sections: demographic characteristics, practice characteristics, bowel preparation regimens used, and recommended follow-up colonoscopy interval based on clinical findings and bowel preparation quality. Proportion of suboptimal bowel preparations per week (none, 1–5 %, 6–10 %, 11–20 % and 21–30 %) was also assessed.

The recommended bowel preparation regimen for a healthy, average risk adult undergoing a screening colonoscopy was ascertained. Participants was asked questions related to the diet prescribed (clear liquid diet only vs. a more liberal diet consisting of clear liquids plus limited food types), use of split-dose bowel preparation, and purgative types recommended (4 l polyethylene glycol without additives [PEG, Colyte®, GoLytely®], sulfate-free PEG

[NuLytely®, TriLyte], low volume PEG [Half-Lytely®], low volume PEG 3350 [MiraLAX®], and MoviPrep® [PEG with ascorbic acid]).

Additionally, we queried the participants about their personal recommendations for follow-up colonoscopy intervals based on a complete evaluation to the cecum. Six scenarios were presented that varied by the quality of the preparation and the clinical findings of the index screening on an average risk adult. In order to minimize interoperator variability, we defined a suboptimal bowel preparation as one that was "fair, poor, or inadequate" that may or may not have resulted in an aborted evaluation, whereas optimal bowel preparation was defined as an "adequate, good, or excellent bowel preparation that resulted in a complete evaluation to the cecum." The clinical findings presented were "within normal limits," "a single adenoma <10 mm," and "a single adenoma 10 mm." based on the U.S. Multi-Society Task Force on Colorectal Cancer and the American Cancer Society guidelines for colonoscopy surveillance after polypectomy [12]. Responses included "less than one year," "1–2 years," "3 years," "4–5 years," "10 years" and "other."

Descriptive analyses were performed to examine demographic, practice characteristics, bowel preparation regimens, and recommended surveillance intervals. Self-reported suboptimal bowel preparations per week were dichotomized as low=<10 % vs. high= 10 %. Bivariate analyses were conducted to examine which of the above factors were associated with self-reported proportion of suboptimal bowel preparation. The categorical data were analyzed with Pearson's chi-square test using Yate's continuity correction and for continuous variables, range, mean and standard deviation was calculated. We also evaluated associations between early follow-up recommendations for suboptimal preparations for each of three clinical scenarios. Significance was determined using p=0.05. All analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC).

Results

Participants ranged in age from 25 to 76 years with a mean age of 48.6 years (standard deviation [SD] 11.3) and the mean number of years of experience in performing colonoscopy was 17.2 (range 1–41 years, SD 10.8) (Table 1). The majority was white males who attended US medical school and were board certified in gastroenterology. More than 80 % of physicians reported that suboptimal bowel preparations occurred in 10 % or less of the colonoscopies they performed per week.

The proportion of suboptimal bowel preparations (<10 % vs. 10 %) per week varied significantly by type of practice (p=0.0002) and affiliation with a teaching hospital affiliation (p=0.008) (Table 2). Of those in hospital/university practice types, 32.1 % reported 10 % suboptimal bowel preparations per week compared to 11.1 % in private practice, respectively. More than twice as many physicians affiliated with a teaching hospital reported the higher proportion of suboptimal bowel preparation per week (23.0 % vs. 10.1 %) compared with those with no such affiliation.

In evaluating the proportion of the patient population by insurance coverage (>25 % vs. 25 %), the majority of physicians reported having relatively few Medicaid-insured (9.2 %) and uninsured patients (1.5 %). Physicians with greater numbers of Medicaid insured individuals more often reported a higher proportion of suboptimal bowel preparation (41.7 % vs. 16.0 %, p=0.002). The reverse was observed among physicians reporting higher proportions of patients insured by Medicare (13.2 % vs. 24.8 %, p=0.0016) and private insurance (15.7 % vs. 28.1 %, p=0.033).

Nearly three-quarters of all participants (71.3 %) recommended only a clear liquid diet prior to colonoscopy and 59.5 % recommended split dosing of the purgative (Table 2).

Polyethylene glycol (4 l PEG without additives, Colyte®, or GoLYTELY®) was the most commonly recommended purgative (56.4 %), followed by MoviPrep® (PEG with ascorbic acid) (40.5 %). Not recommending split dosing of the purgative was associated with a higher proportion of suboptimal bowel preparations per week (26.2 % vs. 12.7 %, $p=0.006$). With regard to purgatives, recommendation of 4 l of PEG without additives and sulfate-free PEG was associated with the higher proportion of suboptimal bowel preparations compared to not using these purgatives (4 l PEG without additives, 22.8 % vs. 12.2 %, $p=0.04$, and sulfate-free PEG 25.6 % vs. 14 %, $p=0.03$). Comparing those who did not recommend MoviPrep® (12.1 %) to those who did (22.3 %), higher proportion of suboptimal bowel preparation was associated with not recommending MoviPrep® ($p=0.05$).

For an average-risk adult with an optimal bowel preparation and findings within normal limits, 82.4 % recommended follow-up in 10 years; for a single adenoma <10 mm, 77.2 % recommended follow-up in 4–5 years; and for a single adenoma 10 mm, 76.0 % recommended follow-up in 3 years (Fig. 1). For the same average risk adult with a suboptimal preparation and findings within normal limits, 42.1 % recommended follow-up in <4–5 years; for a single adenoma <10 mm, 84.2 % recommended follow-up <3 years; and for a single adenoma 10 mm, 46.5 % recommended follow-up <1 year. Differences between interval recommendations at each level of bowel preparation quality (<10 % vs. 10 %) were statistically significant for findings within normal limits ($p<0.0007$), for a small adenoma <10 mm ($p<0.0001$), and for a large adenoma 10 mm ($p<0.0001$). Those reporting a higher proportion of suboptimal preparations more often recommended shorter intervals for each clinical scenario.

Shortened intervals were defined as <4–5 years for findings within normal limits, <3 years for a single small adenoma (10 mm) and <1 year for a single large adenoma (>10 mm) (Table 3). In the setting of a suboptimal preparation, participants in the Northeast were significantly more likely to recommend follow-up in less than 4–5 years for normal findings (53.6 % vs. 39.4 %, $p=0.04$) and less than 3 years for a single small adenoma 10 mm (59.5 % vs. 45.6 %, $p=0.048$). Those who recommended 4 l of PEG without additives were more aggressive overall in the their surveillance for each of the three clinical scenarios and this was statistically significant for large adenomas with 67.2 % reporting <1 year surveillance interval for a large adenoma ($p=0.008$)

Discussion

We found that, in this survey of a nationally representative sample of U.S. gastroenterologists, the surveillance intervals recommended for suboptimal bowel preparation scenarios deviated significantly from recommendations for optimal preparation and those of published surveillance guidelines [11, 12, 19]. Furthermore, the intervals were shortest among physicians in the Northeast section of the country for findings within normal limits and for a single, low-risk adenoma, neither of which can be empirically justified [11, 12]. Those practicing in hospital/university settings or who were affiliated with a teaching hospital reported higher proportions of suboptimal preparations. This finding may be reflective of more diverse patient populations, types of insurance coverage accepted, use of particular preparation types, and procedure volume in the hospital/university setting vs. private practice.

Moreover, we documented that dietary restrictions and purgative type and dosing also impact the proportion of suboptimal bowel preparations reported. Several studies have documented the lack of adherence to guideline follow-up recommendations [13, 18, 20, 21] demonstrating a trend toward shortened intervals that is perhaps instigated by malpractice concerns, lack of knowledge [22, 23], or personal preference over guideline

recommendations [24]. None inquired about bowel preparation quality with respect to interval recommendations, however. Our study is the first to survey a sample of U.S. gastroenterologists regarding surveillance intervals for suboptimal bowel preparation and to evaluate diet and purgative recommendations with regard to self-reported proportion of suboptimal bowel preparation in practice.

To date, only two other studies have evaluated surveillance intervals for suboptimal bowel preparation quality. The first presented a series of colon segment images with cleansing quality varying from impeccable to intermediate quality and asked participants to recommend surveillance intervals for normal findings and two small polyps on index colonoscopy. In this study of 78 physicians attending a conference in Israel, there was considerable inter-observer variation with respect to the interpretation of the bowel quality depicted in the images. Rather than repeating the procedure for the suboptimally prepared colon, most recommended a shorter interval for follow-up with a shift to the left of 2–3 years (p<0.001 for trend) [13]. The second study was a retrospective chart review of 126 medical practices in North Carolina to determine the post-polypectomy surveillance recommendations [18]. For patients with small adenomas, more than one-third of patients were told to return sooner than the recommended guidelines. Bowel preparation quality was missing in 32 % of the records reviewed; nonetheless, the authors found that surveillance interval for low-risk, small adenomas was shorter for those with less than excellent preparation compared to excellent preparation [18].

Our findings suggest that factors, such as the physician's practice type, affiliation with a teaching hospital, dietary restrictions, type of purgative recommended, and patient type as determined by insurance status, may play an important role in the proportion of suboptimal bowel preparations. Others have found that not following bowel preparation instructions, the timing of the start of the procedure, inpatient vs. outpatient status, type of insurance coverage, constipation, use of tricyclic antidepressants, male gender, marital status, and comorbidities such as a history of cirrhosis, stroke, or dementia are all independent predictors of suboptimal bowel preparation [9, 25–27]. We propose that it is feasible that factors related to the physician and his/her practice and patient characteristics, considered in combination rather than individually, influence the proportion of suboptimal bowel preparations encountered in practice.

It is interesting that the self-reported proportion of suboptimal bowel preparations in practice among this cohort of gastroenterologists was far lower than that reported in the literature [28]. This underreporting of the prevalence of suboptimal bowel preparations may be due in part to how suboptimal bowel preparation was defined in this survey ("fair, poor or inadequate"). Alternatively, this underestimation may be reflective of a reporting bias, with respondents hesitant to reveal actual proportions or may be related to a general lack of awareness of the occurrence of suboptimally prepared bowels in their own practices.

Strengths of this study include the use of a national group of gastroenterologists selected randomly from the membership list of a prestigious professional organization. Furthermore, we examined demographic and practice information as well as explored dietary and purgative recommendations in relation to suboptimal bowel preparation prevalence and surveillance interval recommendations. Despite apparent underreporting of the proportion of suboptimal bowel preparations in practice, we observed associations between region and purgative and shortened surveillance intervals recommended for patients with suboptimal preparations.

There were, of course, limitations to this study as well. The response rate to our survey was low at 28.8 % but, is commensurate with the findings of several others [29–34] (response

rates of 32.7 %, 27.1 %, undetermined, 10 %, 5.8 %, and 11 %, respectively). These studies represent a wide range of topics using varying methods to obtain information on participants' opinions, knowledge, and behavior. But, for whatever reason, whether continual bombardment with requests for survey participation, lack of interest/time, or lack of proper incentives, response rate among this group has been demonstrated to be low. The opinions of the members of this organization, however, are held in high esteem and appear to reflect accurately upon current issues in the field. Additionally, our sample size was small and, thus, we may have had insufficient power to detect an effect for other covariates. Our conclusions are based on self-reported behavior of this cohort of physicians regarding the specific scenarios presented in the survey and not upon objective evidence of actual practice that is likely guided by risk assessments, patient symptomology, and previous pathology. That teaching hospital affiliation was associated with proportion of suboptimal bowel preparations, even as underreported as it was in this study, may be difficult to interpret as this term likely encompasses a broad spectrum of practitioner types and patient populations. We also found that the majority of physicians in our study reported   10 % of colonoscopies performed weekly had suboptimal bowel preparation, inconsistent with the literature in this area. Nevertheless, we did find evidence suggestive of a relationship between self-reported high proportion of suboptimal bowel preparation and the type of physician practice, dietary restrictions, and purgative recommendations.

When low-risk findings are encountered during a colonoscopy with suboptimal bowel preparation, gastroenterologists in our study were more likely, particularly in the Northeast, to shorten interval recommendations aggressively. Ramifications of shortened surveillance intervals are numerous—for example, they may compromise the capacity of the system to perform screening colonoscopy [22] and expose patients to potential procedural harm [14]. Additionally, there exists no evidence to support greater detection of pre-cancerous adenomas or cancer to justify these shorter intervals [12] particularly as interval cancers are associated with endoscopists' adenoma detection rate and not with rate of cecal intubation [35]. Rather than shortening the surveillance interval, others have suggested that suboptimal bowel preparations should be followed by a repeat the preparation and procedure immediately [27, 36].

Our study demonstrates the significantly shortened surveillance interval recommendations in the case of suboptimal bowel preparation. Our findings suggest an interrelationship between dietary restriction and purgative type preferences and recommendations, and gastroenterology practice characteristics that warrants additional research. Further investigation into the development of best practice guidelines regarding surveillance of low-risk findings discovered upon colonoscopy with suboptimal bowel preparation is needed to ensure efficient and cost-effective utilization of this procedure.

Acknowledgments

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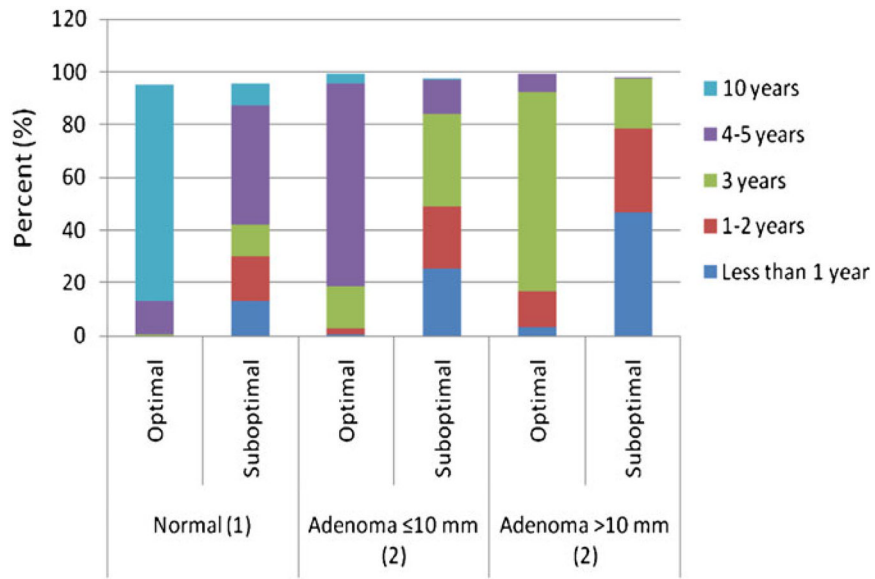
Fig. 1.
Self-reported recommended colonoscopy surveillance intervals for findings (within normal limits, a single adenoma 10 mm, and a single adenoma >10 mm) after index colonoscopy with suboptimal preparation on an average risk individual

Table 1

Characteristics of participating physicians (*n*=288)

	Total	
	N	*%*
Age[a]		
25–39	70	24.9
40–49	77	27.4
50–59	78	27.8
60+	56	19.9
Gender		
Male	245	85.1
Female	43	14.9
Race		
White	205	72.1
Other	80	27.9
Medical school		
U.S.	209	78.6
Non-U.S.	57	21.4
Specialty/Board Cert		
G.I.	242	85.8
Non-G.I.	40	14.2
Years experience performing colonoscopy[b]		
0–6	67	24.5
7–16	71	25.9
17–25	72	26.3
>26	64	23.4
Proportion of suboptimal bowel preparations per week (%)		
None	6	2.2
1–5	125	46.8
6–10	86	32.2
11–20	38	14.2
21–30	12	4.5

[a] Range 25–76 years; mean=48.6 years (SD 11.3)

[b] Range 1–41 years; mean 17.2 years (SD 10.8)

Table 2

Comparison of practice characteristics and bowel preparation recommendations of participating physicians by self-reported level of suboptimal bowel preparations (n=266; <10 %, n=217 and 10 %, n=49)

	Total		% Suboptimal preparations[1]				χ^2	p value
			<10 %		10 %			
	N	%	N	%	N	%		
Practice characteristics								
Region (n=266)							0.228	0.89
Northeast	86	32.3	69	80.2	17	19.8		
South	94	35.3	78	83.0	16	17.0		
West and Hawaii	86	32.3	70	81.4	16	18.6		
Setting (n=263)							0.830	0.66
Urban	145	55.1	119	74.4	26	25.6		
Suburban	100	38.0	80	80.0	20	20.0		
Rural	18	6.8	16	88.9	2	11.1		
Type of practice (n=264)							16.67	0.0002
Private	171	64.8	152	88.9	19	11.1		
Hospital/University	81	30.7	55	67.9	26	32.1		
Other	12	4.5	9	75.0	3	25.0		
Teaching hospital affiliation (n=264)							6.953	0.008
No	99	37.5	89	77.0	10	10.1		
Yes	165	62.5	127	89.9	38	23.0		
No. colonoscopies per week (n=264)							2.868	0.41
10	27	10.2	21	77.8	6	22.2		
11–20	87	33.0	68	78.2	19	21.8		
21–30	93	35.2	81	87.1	12	12.9		
>30	57	21.6	46	80.1	11	19.9		
Patient insurance coverage (n=261)							9.541	0.002
Medicaid								
25 %	237	90.8	199	84.0	38	16.0		
>25 %	24	9.2	14	58.3	10	41.7		

	Total		% Suboptimal preparations[1]				χ²	p value
			<10 %		10 %			
	N	%	N	%	N	%		
Medicare							5.779	0.0016
25 %	117	44.8	88	75.2	29	24.8		
>25 %	144	55.2	125	86.8	19	13.2		
Private insurance							4.552	0.033
25 %	57	21.8	41	71.9	16	28.1		
>25 %	204	78.2	172	84.3	32	15.7		
No insurance							0.118	0.73
25 %	257	96.3	210	81.7	47	18.3		
>25 %	4	1.5	3	75.0	1	25.0		
Bowel preparation recommendations								
Dietary restrictions^b (n=265)							0.952	0.33
Liberal diet	76	28.7	65	85.5	11	14.5		
Clear liquid only	189	71.3	152	80.4	37	19.6		
Split dose (n=264)							7.714	0.006
No	107	40.5	79	73.8	28	26.2		
Yes	157	59.5	137	87.3	20	12.7		
Purgatives (n=264)								
4 l PEG (no additives)							4.254	0.04
No	115	43.6	101	87.7	14	12.2		
Yes	149	56.4	115	77.2	34	22.8		
Sulfate-free PEG							4.991	0.03
No	174	65.9	149	85.6	25	14.4		
Yes	90	34.1	67	74.4	23	25.6		
Low volume PEG							0.898	0.34
No	167	63.3	140	83.8	27	16.2		
Yes	97	36.7	76	78.4	21	21.6		
Low volume PEG 3350							0.027	0.87
No	165	62.5	136	82.4	29	17.6		
Yes	99	37.5	80	80.8	19	19.2		

	Total		% Suboptimal preparations[1]				χ^2	p value
			<10 %		10 %			
	N	%	N	%	N	%		
MoviPrep®							3.745	0.05
No	157	59.5	122	77.7	35	22.3		
Yes	107	40.5	94	87.9	13	12.1		

PEG=4 l polyethylene glycol without additives, Colyte®, GoLYTELY®, sulfate-free PEG = NuLYTELY®, TriLyte®; low volume PEG = HalfLytely®; low volume PEG 3350 = MiraLAX®; MoviPrep® = PEG with ascorbic acid

[a] Self-reported proportion of suboptimal (fair, poor, or inadequate) bowel preparations per week

[b] Clear liquid only diet vs. liberal diet = clear liquid diet plus certain allowable food types

Table 3

Comparison of various physician and practice characteristics and purgative recommendations with self-reported shortened surveillance intervals for suboptimal preparation quality and clinical findings

	Within normal limits <4–5 years		Single adenoma 10 mm <3 years		Single adenoma >10 mm <1 year	
	N (%)	p value	N (%)	p value	N (%)	p value
Region		0.04		0.048		0.11
Northeast	45 (53.6)		50 (59.5)		47 (55.3)	
Other	69 (39.4)		82 (45.6)		79 (43.9)	
Practice type		0.53		0.56		0.07
Private	70 (42.4)		80 (48.5)		71 (42.8)	
Other	44 (47.3)		52 (53.1)		54 (55.1)	
Teaching hospital affiliation		0.15		0.92		0.30
Yes	77 (48.1)		84 (50.9)		83 (50.3)	
No	37 (38.1)		48 (49.5)		42 (42.9)	
Proportion of suboptimal preparations per week[a]		0.63		0.80		0.89
10	21 (48.8)		22 (47.8)		21 (45.7)	
>10	90 (43.5)		107 (51.2)		101 (48.1)	
Diet						
Clear liquid	108 (97.3)	0.16	127 (98.5)	0.99	121 (98.2)	1.00
Low residue	29 (25.7)	0.89	28 (21.4)	0.27	25 (20.0)	0.10
Split dose		0.73		0.12		0.79
Yes	64 (43.0)		70 (45.8)		102 (47.7)	
No	50 (45.9)		62 (56.1)		18 (43.9)	
Purgative						
4 l PEG no additives	69 (61.1)	0.35	81 (61.8)	0.28	84 (67.2)	0.008
Sulfate-free PEG	37 (32.7)	1.00	42 (32.1)	0.83	47 (37.6)	0.16
Low volume PEG	42 (37.2)	0.84	45 (34.4)	0.64	47 (37.6)	0.70
Low volume PEG 3350	41 (36.3)	0.98	47 (35.9)	0.94	46 (36.8)	1.00
MoviPrep®	42 (37.2)	0.22	53 (40.5)	0.84	51 (40.8)	0.98

Suboptimal preparation defined as inadequate, fair or poor preparation

PEG=4 l polyethylene glycol without additives, Colyte®, GoLYTELY®, sulfate-free PEG = NuLYTELY®, TriLyte; low volume PEG = Halflytely®; low volume PEG 3350 = Miralax®; MoviPrep® = PEG with ascorbic acid

[a]Self-reported proportion of suboptimal (fair, poor, or inadequate) bowel preparations per week