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The Impact of Bowel Cleansing on Follow-Up Recommendations in Average-Risk Patients With a Normal Colonoscopy

Stacy B. Menees, MD, MS¹, Eric Elliott, MPH¹, Shail Govani, MD¹, Constantinos Anastassiades, MD², Stephanie Judd, MD³, Annette Urganus, MPH⁴, Suzanna Boyce, MPA⁵, and Philip Schoenfeld, MD, MEd, MSc (Epi)^{1,4}

¹Division of Gastroenterology, University of Michigan Health System, Ann Arbor, Michigan, USA

²Division of Gastroenterology, Case Western Reserve University Hospital, Cleveland, Ohio, USA

³Department of Internal Medicine, Wayne State University, Detroit, Michigan, USA

⁴Division of Gastroenterology, Ann Arbor Veterans' Administration Hospital, Chicago, Illinois, USA

⁵Department of Internal Medicine, Duke University, Durham, North Carolina, USA

Abstract

OBJECTIVES—Repeat colonoscopy in 10 years after a normal screening colonoscopy is recommended in an average-risk patient, and it has been proposed by American Gastroenterological Association (AGA), American College of Gastroenterology (ACG), and American Society for Gastrointestinal Endoscopy (ASGE) as a quality measure. However, there are little quantitative data about adherence to this recommendation or factors that may improve adherence. Our study quantifies adherence to this recommendation and the impact of suboptimal bowel preparation on adherence.

METHODS—In this retrospective database study, endoscopy reports of average-risk individuals 50 years old with a normal screening colonoscopy were reviewed. Quality of colon cleansing was recorded using the Aronchick scale as excellent, good, fair, or poor. Main outcome measurements were quality of bowel preparation and recommendation for timing of repeat colonoscopy. Recommendations were considered consistent with guidelines if 10-year follow-up was documented after excellent, good, or fair prep or if 1-year follow-up was recommended after poor prep.

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Correspondence: Stacy B. Menees, MD, MS, Division of Gastroenterology, University of Michigan Health System, 3912 Taubman Center, SPC 5362, Ann Arbor, Michigan 48109-5362, USA. sbartnik@med.umich.edu.

Guarantor of the article: Stacy B. Menees, MD, MS.

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Specific author contributions: Stacy B. Menees: data acquisition, statistical analysis, analysis and interpretation of data, drafting of manuscript, and draft revision; Eric Elliot: data acquisition, statistical analysis, and draft revision; Shail Govani and Constantinos Anastassiades: data acquisition and draft revision; Stephanie Judd, Annette Urganus, and Suzanna Boyce: data acquisition; Philip Schoenfeld: study concept and design, analysis and interpretation of data, critical revision of the manuscript for important intellectual content, obtained funding, and study supervision.

RESULTS—Among 1,387 eligible patients, recommendations for follow-up colonoscopy inconsistent with guidelines were seen in 332 (23.9%) subjects. By bowel preparation quality, 15.3% of excellent/ good, 75% of fair, and 31.6% of poor bowel preparations were assigned recommendations inconsistent with guidelines ($P < 0.001$). Patients with fair (odds ratio = 18.0; 95% confidence interval 12.0–28.0) were more likely to have recommendations inconsistent with guidelines compared with patients with excellent/good preps.

CONCLUSIONS—Recommendations inconsistent with guidelines for 10-year intervals after a normal colonoscopy occurred in >20% of patients. Minimizing “fair” bowel preparations may be a helpful intervention to improve adherence to these recommendations.

INTRODUCTION

Colonoscopy is the primary modality for prevention of colorectal cancer (CRC) per multisociety guidelines (1), and the cost effectiveness of CRC screening with colonoscopy is primarily dependent on high-quality baseline examination and adherence to guideline recommendations for timing of repeat screening colonoscopy (2). Of course, guideline recommendations are not followed in every patient and endoscopists do not always recommend 10-year intervals after a normal screening colonoscopy in an average-risk patient (3–5). However, endoscopists’ adherence to these guideline recommendations will come under close scrutiny very soon.

Currently, endoscopists are asked to simply report different quality indicators, such as cecal intubation or adenoma detection rate, to Centers for Medicare and Medicaid Services (CMS) through the Physician Quality Reporting System (PQRS). CMS proposed a new quality measure for the 2013 PQRS: frequency of recommending repeat colonoscopy in 10 years after a normal colonoscopy in an average-risk patient (6). When endoscopists report this and multiple other quality indicators, they receive a small bonus in Medicare payments. By 2014, failure to report will result in a reduction in Medicare payments. However, this system does not account for the actual quality of performance of colonoscopy; it only requires reporting of quality indicators. It does not adjust payment for services based upon successfully meeting numeric thresholds for quality indicators (e.g., cecal intubation in > 95% of colonoscopies for CRC screening). However, by 2015, a value-based quality index is to be enacted where endoscopists’ success at achieving multiple quality indicators will be quantified and payments for colonoscopy will be adjusted based on this to-be-determined formula.

What should be the threshold for recommending a 10-year interval after a normal screening colonoscopy? Over 80 % of cases? Over 90 %? Quantifiable data will be needed to set appropriate numerical thresholds. Also, one purpose of quality indicators is to improve performance, and hence it is important to identify factors associated with suboptimal performance that can be addressed through quality improvement programs.

Lack of knowledge about guideline recommendations is not an issue based upon survey studies (5,7). However, endoscopists vary from guideline recommendations when the bowel preparation is suboptimal and they are concerned that adenomas could be missed. This is an understandable concern. Compared with “fair” or “suboptimal” bowel preparation,

“excellent” or “optimal” bowel preparation improves identification of polyps (8–11). Based on survey studies using hypothetical patient scenarios and photographs of bowel preparation, increasingly shorter intervals for repeat colonoscopy are recommended for worse categories of bowel cleansing (12,13). Although this reflects “self-reported” practices and may be prone to response bias (14–16), it supports the rationale that quality of bowel preparation affects adherence to guideline recommendations (17).

The aim of our study is to quantify frequency of adherence to recommending repeat colonoscopy in 10 years after a normal screening colonoscopy in an average-risk patient and to assess the impact of bowel preparation quality, demographic factors, and procedural factors on adherence to guideline recommendations. We hypothesize that fair bowel preparation is highly associated with recommendations to repeat colonoscopy sooner than 10 years.

Methods

Study design

This is a retrospective database study supplemented by chart review from the Ann Arbor Veterans Affairs Health Care System (VAHCS) in-hospital endoscopy suite, the University of Michigan in-hospital medical procedure unit, and two University of Michigan out-patient ambulatory surgery centers (Livonia, MI and Ann Arbor, MI). Medical records of consecutive average-risk patients 50 years old undergoing colonoscopy for CRC screening between 1 January 2009 and 31 December 2009 were reviewed. These dates preceded institution of PM/AM split-dose bowel preparation protocols in 2010, and hence these data reflect outcomes with PM-only bowel preparation protocols. Inclusion criteria were average-risk outpatients referred for CRC screening colonoscopy without any polyps identified during colonoscopy. Subjects were excluded for: concurrent gastrointestinal (GI) symptoms (i.e., one of the indications for colonoscopy was listed as anemia, overt or obscure GI blood loss, abdominal pain, diarrhea, unexplained weight loss, and so on); family history of CRC; personal history of CRC, colon polyps, hereditary CRC syndrome, inflammatory bowel disease; detection of any colon polyps during colonoscopy, detection of mucosal abnormalities during colonoscopy that required biopsy, or incomplete colonoscopies (i.e., failure to visualize the appendiceal orifice and cecum). Patients with follow-up recommendations for “Barium Enema” or “Discontinue due to age” were also excluded. Institutional Review Board approval was obtained at the Ann Arbor VAHCS and University of Michigan before study initiation.

Protocol for bowel preparation and definition of bowel preparation quality

If the laxative was polyethylene glycol, HalfLyte, MoviPrep, NuLYTELY, or TriLyte, the patients were instructed to follow the Food and Drug Administration (FDA)-approved instructions for consuming the bowel preparation using a PM-only protocol. For MiraLAX / Gatorade, patients took two tablets of bisacodyl between 12 PM and 6 PM and followed 4 h later by consumption of 238 g of MiraLAX mixed in 64 oz of Gatorade.

Bowel preparation quality and other endoscopic data were reported via the ProVation Medical Systems v.42 and v5.0 (Wolters Kluwer Health, Minneapolis, MN) at the Ann Arbor VAHCS and University of Michigan endoscopy sites, respectively, using the Aronchick scale that categorizes bowel cleansing as follows: excellent: >95% of mucosa visualized; good: 90–95% of mucosa visualized, fair: 80 – 90 % of mucosa visualized, and poor: <80% mucosal visualization (18). We collapsed excellent and good categories for simplicity because the clinical importance of 90–95 vs. >95% visualization of the mucosa is unclear.

Endoscopist recommendation intervals

Data on the endoscopists' recommendation for follow-up screening colonoscopy were abstracted from patient colonoscopy report forms. Recommendations consistent with guidelines were defined as follow-up in 10 years for excellent, good, or fair bowel cleansing or 1 year if bowel preparation quality was rated poor (2). Although guidelines published in 2009 or earlier do not specifically recommend the appropriate interval for repeat colonoscopy after poor bowel preparation (2), they do state that follow-up colonoscopy should be scheduled at a “prompt,” “a relatively short interval”, and “within 6 months” (19–22). We believe this common-sense approach was understood by the vast majority of endoscopists practicing in 2009 and that they would not consider it appropriate to recommend repeat screening colonoscopy at intervals >1 year after poor bowel preparation in an average-risk patient referred for CRC screening with colonoscopy. In fact, the 2012 multisociety guidelines now specifically recommend repeat colonoscopy in 1 year after poor bowel preparation (23). Failure to provide a recommendation for repeat screening colonoscopy was also considered inconsistent with guideline recommendations as endoscopists are required to make this recommendation as part of reporting in PQRS.

Subject and procedure data

Data were collected on age, gender, body mass index, race /ethnicity, concurrent narcotics and tricyclic antidepressant usage, presence /absence of diabetes, type of bowel preparation agent used, whether a GI fellow participated, endoscopists' categorization of procedural difficulty, and cecal intubation. Specific endoscopist characteristics were not collected because of privacy issues raised by our institutional review board that stated that all endoscopists would need to provide informed consent even if they no longer practiced at the University of Michigan as collection of these data might be used to retrospectively assess these endoscopists.

Statistical analysis

Bowel preparation quality was categorized as excellent/good, fair, or poor. Recommendation appropriateness was a dichotomous variable: consistent with guideline recommendations vs. inconsistent with guideline recommendations. The χ^2 tests and Student's *t*-tests were used to assess study population differences based on bowel preparation quality and based on whether or not their recommendation was consistent with guidelines. A saturated multivariate logistic regression model was used to determine independent predictors of

receiving a recommendation inconsistent with guidelines. Database management and statistical analysis was performed using SAS 9.2 (SAS Institute, Cary, NC).

Results

Demographic data

Between 1 January 2009 and 31 December 2009, 4,527 out-patient colonoscopies were performed for an indication of “average-risk” and “screening” at the Ann Arbor VAHCS and University of Michigan. After applying exclusion criteria, 1,387 normal colonoscopies remained for analysis. These 1,387 colonoscopies were performed by 56 different gastroenterologists, excluding GI fellows. A total of 18 GI fellows participated in 18.7 % of these endoscopic procedures. The majority (89.7 %) of procedures were classified as technically “not difficult.” The mean age of the subjects was 56.7 ± 7.1 years; mean body mass index was $28.2 \pm 5.7 \text{ kg/m}^2$, and the subjects were predominantly Caucasian (77.6 %) and male (50.9 %). Demographic differences between groups based on preparation quality (Table 1a) and recommendation type (Table 1b) are provided.

Follow-up recommendations for repeat colonoscopy

Recommendations that were inconsistent with guidelines were given in 23.9% (332/1,387) of average-risk patients with a normal screening colonoscopy (Table 2). Preparations rated as excellent /good had the highest frequency (84.7 %) of recommendations for repeat colonoscopy in 10 years. Of the preparations, 25 % rated as fair were recommended for repeat colonoscopy in 10 years. Preparations rated as poor had a high frequency (65.9 %) of being recommended to have repeat colonoscopy in 1 year.

Factors associated with follow-up recommendations inconsistent with guidelines

Crude estimates for predictors of recommendations inconsistent with guidelines are given in Table 3, whereas Table 4 demonstrates the effect of predictors after adjustment for all data collected. Bowel preparation quality with a rating of fair or poor was associated with an 18-fold and 2.3-fold increase in the odds of receiving a recommendation inconsistent with guidelines, respectively, along with age ≥ 70 (odds ratio=2.2; 95% confidence interval 1.2–4.1).

Discussion

This is the first multicenter endoscopic database study to assess the impact of bowel preparation on endoscopists' recommendations to repeat colonoscopy in 10 years after a normal CRC screening colonoscopy. In our study, recommendations inconsistent with guidelines were provided in 23.9 % of all cases, and fair bowel cleansing was strongly associated with inconsistent recommendations. These findings provide a starting point to establish an acceptable threshold for frequency of adherence to guideline recommendations as part of a quality improvement program and for development of national benchmarks by organizations such as CMS. These data also suggest that interventions that increase the frequency of excellent /good bowel preparation may minimize recommendations inconsistent with guidelines.

Our study methodology differs significantly from previous survey studies because it reflects actual practice, and is not influenced by response bias or the effect of a trial on endoscopists' behavior (i.e., Hawthorne effect) (16,24,25). Our study estimated that 75% of patients with a fair cleansing were instructed to have a repeat colonoscopy in <10 years compared with 15.3% with excellent/ good preparations. This is consistent with our pilot study (26). In multivariate analysis, fair bowel cleansing was associated with an 18-fold increase of receiving a recommendation inconsistent with guidelines compared with excellent / good bowel cleansing. Notably, 2012 multisociety CRC guidelines emphasize the importance of "adequate" preps that can identify polyps >5mm vs. "inadequate." In the future, the addition of "adequate" or "inadequate" to bowel preparation classification will help determine if endoscopists provide recommendations consistent with guidelines.

Maximizing excellent /good preps may also maximize recommendations to repeat colonoscopy in 10 years after a normal screening colonoscopy. 3e PM/AM split-dosing of the bowel preparation increases the frequency of excellent/good bowel cleansing based upon current guidelines (2) and multiple randomized controlled trials (27). Nevertheless, adoption of this standard has been gradual (28), and many endoscopists continue to utilize PM-only bowel preparation protocols, possibly because of concerns that patients will be unwilling to rise early to complete the AM dosing of bowel preparation (29). However, patients can be easily educated about split-dose bowel preparation (2). Our data reflect outcomes with PM-only bowel preparation. If an endoscopist frequently reports fair bowel cleansing and frequently recommends repeat colonoscopy sooner than 10 years after a normal screening colonoscopy, then converting to PM/AM split-dosing may be the most appropriate quality improvement intervention.

Our study has several potential limitations. This is a retrospective study that reflects PM-only dosing of bowel preparation. There may also be variability among physician reporting of bowel preparation quality that is not captured. Although a validated scale to assess quality of bowel cleansing, such as the Boston Bowel Preparation Scale, was not used, the nonvalidated Aronchick scale is used widely (18,30,31), and this may enhance the generalizability of our results.

In conclusion, our study demonstrates that endoscopists make recommendations inconsistent with guidelines frequently after a normal screening colonoscopy. Fair bowel cleansing is the factor most commonly associated with recommendations inconsistent with guidelines, and hence institution of protocols to improve bowel cleansing may be appropriate for suboptimal performers.

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References

1. Levin B, Lieberman DA, McFarland B, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. *Gastroenterology*. 2008; 134:1570–95. [PubMed: 18384785]

2. Rex DK, Johnson DA, Anderson JC, et al. American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol.* 2009; 104:739–50. [PubMed: 19240699]
3. Krist AH, Jones RM, Woolf SH, et al. Timing of repeat colonoscopy: disparity between guidelines and endoscopists' recommendation. *Am J Prev Med.* 2007; 33:471–8. [PubMed: 18022063]
4. Goodwin JS, Singh A, Reddy N, et al. Overuse of screening colonoscopy in the Medicare population. *Arch Intern Med.* 2011; 171:1335–43. [PubMed: 21555653]
5. Saini SD, Nayak RS, Kuhn L, et al. Why don't gastroenterologists follow colon polyp surveillance guidelines?: results of a national survey. *J Clin Gastroenterol.* 2009; 43:554–8. [PubMed: 19542818]
6. Quality Program Highlights in 2013 Proposed Medicare Rules 2012 [cited 2012 July 12]. Available from: http://www.gastro.org/journals-publications/aga-edigest/archive/aga_edigest_july_12_2012
7. Fisher D, Grubber JM, Grambow S, et al. Factors associated with non-adherence to colonoscopy interval guidelines in an integrated managed care system. *Gastroenterology.* 2012; 142 (Suppl):A344.
8. Harewood GC, Sharma VK, de Garmo P. Impact of colonoscopy preparation quality on detection of suspected colonic neoplasia. *Gastrointest Endosc.* 2003; 58:76–9. [PubMed: 12838225]
9. Froehlich F, Wietlisbach V, Gonvers JJ, et al. Impact of colonic cleansing on quality and diagnostic yield of colonoscopy: the European Panel of Appropriateness of Gastrointestinal Endoscopy European multicenter study. *Gastrointest Endosc.* 2005; 61:378–84. [PubMed: 15758907]
10. Parra-Blanco A, Nicolas-Perez D, Gimeno-Garcia A, et al. The timing of bowel preparation before colonoscopy determines the quality of cleansing, and is a significant factor contributing to the detection of flat lesions: a randomized study. *World J Gastroenterol.* 2006; 12:6161–6. [PubMed: 17036388]
11. Bowles CJ, Leicester R, Romaya C, et al. A prospective study of colonoscopy practice in the UK today: are we adequately prepared for national colorectal cancer screening tomorrow? *Gut.* 2004; 53:277–83. [PubMed: 14724164]
12. Ben-Horin S, Bar-Meir S, Avidan B. The impact of colon cleanliness assessment on endoscopists' recommendations for follow-up colonoscopy. *Am J Gastroenterol.* 2007; 102:2680–5. [PubMed: 17714555]
13. Larsen M, Hills N, Terdiman J. The impact of the quality of colon preparation on follow-up colonoscopy recommendations. *Am J Gastroenterol.* 2011; 106:2058–62. [PubMed: 22138933]
14. Campbell DT, Fiske DW. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychol Bull.* 1959; 56:81–105. [PubMed: 13634291]
15. Graham, JW.; Collins, NL.; Donaldson, SI., et al. Understanding and controlling for response bias: confirmatory factor analysis of multitrait-multimethod data. In: Steyer, R.; Wender, KF.; Widaman, KF., editors. *Psychometric Methodology.* Stuttgart; New York: 1993. p. 585-90.
16. Donaldson SI, Grant-Vallone EJ. Understanding self-report bias in organization behavior research. *J Bus Psychol.* 2002; 17:245–60.
17. Ransohoff DF, Yankaskas B, Gizlice Z, et al. Recommendations for post-polypectomy surveillance in community practice. *Dig Dis Sci.* 2011; 56:2623–30. [PubMed: 21698368]
18. Aronchick CA, Lipshutz WH, Wright H, et al. Validation of an instrument to assess colon cleansing. *Am J Gastroenterol.* 1999; 94:2667.
19. Rex DK, Imperiale TF, Latinovich DR, et al. Impact of bowel preparation on efficiency and cost of colonoscopy. *Am J Gastroenterol.* 2002; 97:1696–700. [PubMed: 12135020]
20. Bond JH. Should the quality of preparation impact postcolonoscopy follow-up recommendations? *Am J Gastroenterol.* 2007; 102:2686–7. [PubMed: 18042104]
21. Levin TR. Dealing with uncertainty: surveillance colonoscopy after polypectomy. *Am J Gastroenterol.* 2007; 102:1745–7. [PubMed: 17686069]
22. Rex DK, Bond JH, Feld AD. Medical-legal risks of incident cancers after clearing colonoscopy. *Am J Gastroenterol.* 2001; 96:952–7. [PubMed: 11316211]
23. Lieberman DA, Rex DK, Winawer SJ, et al. Guidelines for colonoscopy surveillance after screening and polypectomy: a consensus update by the US multi-society task force on colorectal cancer. *Gastroenterology.* 2012; 143:844–57. [PubMed: 22763141]

24. McCarney R, Warner J, Iliffe S, et al. The Hawthorne Effect: a randomised, controlled trial. *BMC Med Res Methodol.* 2007; 7:30. [PubMed: 17608932]
25. Fox NS, Brennan JS, Chasen ST. Clinical estimation of fetal weight and the Hawthorne effect. *Eur J Obstet Gynecol Reprod Biol.* 2008; 141:111–4. [PubMed: 18771841]
26. Zeglis M, Chang M, Kim HM, et al. Effect of bowel preparation quality on screening interval after a normal screening colonoscopy. *Gastrointest Endosc.* 2006; 63:AB197.
27. Cohen LB. Split dosing of bowel preparations for colonoscopy: an analysis of its efficacy, safety, and tolerability. *Gastrointest Endosc.* 2010; 72:406–12. [PubMed: 20579994]
28. Gagovic V, Rex DK. Gastroenterologists' patient instructions for oral sodium phosphate solution for colonoscopy preparation: a survey among gastroenterologists in the state of Indiana. *J Clin Gastroenterol.* 2008; 42:1070–3. [PubMed: 18633334]
29. Unger RZ, Amstutz SP, Seo da H, et al. Willingness to undergo split-dose bowel preparation for colonoscopy and compliance with split-dose instructions. *Dig Dis Sci.* 2010; 55:2030–4. [PubMed: 20082216]
30. Rostom A, Jolicoeur E. Validation of a new scale for the assessment of bowel preparation quality. *Gastrointest Endosc.* 2004; 59:482–6. [PubMed: 15044882]
31. Lai EJ, Calderwood AH, Doros G, et al. The Boston bowel preparation scale: a valid and reliable instrument for colonoscopy-oriented research. *Gastrointest Endosc.* 2009; 69 (3 Part 2):620–5. [PubMed: 19136102]

Study Highlights

WHAT IS CURRENT KNOWLEDGE

- Repeat colonoscopy in 10 years after a normal screening colonoscopy is recommended in an average-risk patient.
- This has been proposed by American Gastroenterological Association (AGA), American College of Gastroenterology (ACG), and American Society for Gastrointestinal Endoscopy (ASGE) as a quality measure.

WHAT IS NEW HERE

- Preparation quality has a significant impact on gastroenterologists' interval colonoscopy recommendation.
- Almost 25% of average-risk patients with normal colonoscopy have recommendations for follow-up colonoscopy that are inconsistent with guidelines.
- Fair and poor/inadequate bowel preparations are the leading contributors.
- Continued emphasis on optimization of bowel prep is needed.

Table 1a

Distribution of study subject ($N=1,387$) characteristics with a normal colonoscopy by bowel preparation quality

Characteristic (%)	Normal colonoscopy			P value
	Excellent/good prep quality	Fair prep quality	Poor prep quality	
<i>Age, years</i>				
50–59	793 (82.1)	121 (12.5)	52 (5.4)	
60–69	273 (80.8)	44 (13.0)	21 (6.2)	0.58
70 +	65 (78.3)	15 (18.1)	3 (3.6)	
<i>Gender</i>				
Male	569 (80.6)	103 (14.6)	34 (4.8)	0.12
Female	562 (82.5)	77 (11.3)	42 (6.2)	
<i>Race/ethnicity</i>				
White	886 (82.3)	138 (12.8)	52 (4.8)	
African American	77 (73.3)	17 (16.2)	11 (10.5)	0.10
Other	85 (80.2)	14 (13.2)	7 (6.6)	
<i>BMI (kg/m²)</i>				
< 25	313 (84.8)	39 (10.6)	17 (4.6)	
25– < 30	427 (82.9)	63 (12.2)	25 (4.9)	0.05
30– < 35	198 (75.9)	48 (18.4)	15 (5.8)	
35	126 (77.3)	24 (14.7)	13 (8.0)	
Narcotics use	96 (8.5)	25 (14.0)	13 (17.1)	< 0.01
TCA use	21 (1.9)	7 (3.9)	3 (4.0)	0.13
Diabetic	97 (8.6)	39 (21.9)	21 (27.6)	< 0.001
GI fellow present	198 (17.5)	48 (26.7)	14 (18.4)	0.01
<i>Bowel prep type</i>				
8L PEG-3350	176 (77.9)	40 (17.7)	10 (4.4)	
4L PEG-3350	481 (79.4)	82 (13.5)	43 (7.1)	0.02
MiraLAX/Gatorade	273 (86.7)	31 (9.8)	11 (3.5)	
Other	162 (83.9)	20 (10.4)	11 (5.7)	
<i>Endoscopy site (%)</i>				
HOPD	187 (77.9)	36 (15.0)	17 (7.1)	
ASC	742 (84.4)	92 (10.5)	45 (5.1)	< 0.01
VA endoscopy unit	202 (75.4)	52 (19.4)	14 (5.2)	
<i>Procedure difficulty</i>				
Not difficult	988 (83.2)	138 (11.6)	62 (5.2)	< 0.001
Some difficulty	96 (66.7)	36 (25.0)	12 (8.3)	

ASC, ambulatory surgery center; BMI, body mass index; GI, gastrointestinal; HOPD, hospital outpatient department; PEG, polyethylene glycol; prep, preparation; TCA, tricyclic antidepressant; VA, veterans administration.

Table 1b

Distribution of study subject ($N=1,387$) characteristics with a normal colonoscopy by appropriateness of endoscopist recommendations

Normal colonoscopy			
Characteristic (%)	Appropriate recommendation ^a	Inappropriate recommendation ^a	<i>P</i> value
<i>Age, years</i>			
50–59	747 (77.3)	219 (22.7)	
60–69	256 (75.7)	82 (24.3)	0.01
70 +	52 (62.7)	31 (37.4)	
<i>Gender</i>			
Male	544 (77.1)	162 (23.0)	0.38
Female	511 (75.0)	170 (25.0)	
<i>Race/ethnicity</i>			
White	820 (76.2)	256 (23.8)	
African American	77 (73.3)	28 (26.7)	0.50
Other ^b	76 (71.7)	31 (28.3)	
<i>BMI (kg/m²)</i>			
< 25	294 (79.7)	75 (20.3)	
25– < 30	390 (75.7)	125 (24.3)	0.15
30– < 35	188 (72.0)	73 (28.0)	
≥ 35	121 (74.2)	42 (25.8)	
Narcotics use	90 (8.6)	44 (13.3)	0.01
TCA use	24 (2.3)	7 (2.1)	0.85
Diabetic	101 (9.7)	56 (16.9)	< 0.001
GI fellow present	199 (18.9)	61 (18.4)	0.84
<i>Bowel prep type</i>			
8L PEG-3350	177 (78.3)	49 (21.7)	
4L PEG-3350	442 (72.9)	164 (27.1)	0.02
MiraLAX/Gatorade	259 (82.2)	56 (17.8)	
Other ^c	148 (76.7)	45 (23.3)	
<i>Bowel preparation quality</i>			
Excellent/good	958 (84.7)	173 (15.3)	
Fair	45 (25.0)	135 (75.0)	< 0.001
Poor	52 (68.4)	24 (31.6)	
<i>Endoscopy site (%)</i>			
HOPD	173 (72.1)	67 (27.9)	
ASC	676 (76.9)	203 (23.1)	0.28
VA endoscopy unit	206 (76.9)	62 (23.1)	
<i>Procedure difficulty</i>			

Normal colonoscopy			
Characteristic (%)	Appropriate recommendation ^a	Inappropriate recommendation ^a	P value
Not difficult	917 (77.2)	271 (22.8)	< 0.01
Some difficulty ^d	94 (65.3)	50 (34.7)	

ASC, ambulatory surgery center; BMI, body mass index; GI, gastrointestinal; HOPD, hospital outpatient department; PEG, polyethylene glycol; prep, preparation; TCA, tricyclic antidepressant; VA, veterans administration.

^a Appropriate defined as 10 years or 1 year if poor preparation quality. Inappropriate defined as any other recommendation or no recommendation provided.

^b "Other" includes Hispanic, Asian, Native American, Middle Eastern, or those reported bi- or multi-racial.

^c Includes Sodium Phosphate/Osmoprep and Half-Lytely.

^d Endoscopist documented the colonoscopy was "Somewhat Difficult," "Difficult Procedure," or "Technically Difficult."

Table 2

Frequency distribution of interval recommendations by quality of bowel preparation

Follow-up interval	Bowel preparation quality		
	Excellent/good, <i>n</i> (%)	Fair, <i>n</i> (%)	Poor, <i>n</i> (%)
10 years	958 (84.7)	45 (25.0)	2 (2.6)
5–10 years	94 (8.3)	36 (20.0)	3 (3.9)
5 years	14 (1.2)	62 (34.4)	10 (13.2)
2–4 years	0 (0.0)	18 (10.0)	10 (13.2)
1 year	4 (0.4)	4 (2.2)	50 (65.9)
No recommendation	61 (5.4)	15 (8.3)	1 (1.3)
Total	1,131	180	76

Table 3

Crude estimates (OR (95% CIs)) of predictors of inappropriate follow-up recommendations by the gastroenterologist at the time of colonoscopy

Predictors	Inappropriate recommendations, OR (95% CI)
<i>Age, years</i>	
50–59	1
60–69	1.1 (0.82–1.5)
70–75	2.0 (1.3–3.3)
Male gender	0.91 (0.70–1.1)
<i>Race/ethnicity</i>	
Caucasian	1
African American	1.2 (0.74–1.8)
Other	1.3 (0.81–2.0)
<i>BMI (kg/m²)</i>	
< 30	1
30	1.3 (0.98–1.7)
Narcotics use	1.6 (1.1–2.4)
TCA use	0.92 (0.39–2.2)
Diabetic	1.9 (1.3–2.7)
GI fellow present	0.97 (0.71–1.3)
<i>Bowel prep quality</i>	
Excellent/good	1
Fair	17 (11.0–24.0)
Poor	2.6 (1.5–4.2)
<i>Bowel prep type</i>	
4L PEG-3350	1
8L PEG-3350	0.75 (0.52–1.1)
MiraLAX/Gatorade	0.58 (0.42–0.82)
Other	0.82 (0.56–1.2)
<i>Endoscopy site</i>	
Ambulatory surgery centers	1
Academic hospital unit	1.3 (0.93–1.8)
Veterans affairs unit	1.0 (0.73–1.4)
<i>Procedure difficulty</i>	
No difficulty	1
At least some difficulty	1.8 (1.2–2.6)

BMI, body mass index; CI, confidence interval; GI, gastrointestinal; OR, odds ratio; PEG, polyethylene glycol; prep, preparation; TCA, tricyclic antidepressant.

Table 4

Multivariable logistic regression (OR (95% CIs)) estimates of predictors of inappropriate recommendations in a normal screening colonoscopy

Characteristics	Inappropriate recommendations ^a , OR (95% CI)
Fair prep quality	18 (12–28)
Poor prep quality	2.3 (1.2–4.1)
MiraLAX/Gatorade	0.65 (0.43–0.97)
Age ≥ 70 years	2.2 (1.2–4.1)
Narcotics use	1.4 (0.82–2.4)
Diabetic	1.3 (0.79–2.2)
Difficult procedure	1.1 (0.65–1.8)

CI, confidence interval; OR, odds ratio; prep, preparation.

^aModel adjusted for all covariates.