

Rates of Suboptimal Preparation for Colonoscopy Differ Markedly Between Providers

Impact on Adenoma Detection Rates

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Goals: We sought to determine if providers who have higher standards for optimal bowel preparation might be more fastidious in their examination of the colon and, therefore, have higher adenoma detection rates (ADRs).

Background: ADRs are a reliable and objective marker of colonoscopy performance. Suboptimal bowel preparation impacts upon adenoma detection; however, physicians have varying standards for grading bowel preparation.

Study: Endoscopy reports of patients who underwent screening colonoscopy in 2011 at 1 academic medical center were reviewed. Bowel preparations labeled “fair,” “poor,” or “unsatisfactory” were considered suboptimal. The ADR was calculated for each endoscopy provider and was correlated with the provider’s suboptimal preparation rate. Logistic regression was used to determine independent predictors of adenoma detection.

Results: 1649 examinations from 11 separate gastroenterologists were included. Preparation was suboptimal in 22% of examinations overall. The rate of suboptimal preparations varied widely among providers, ranging from 3% to 40%. Overall ADR was 23%, with a range of 13% to 31%. Providers’ suboptimal preparation rate was not significantly correlated with ADR ($r = -0.22$, $P = 0.51$). After adjusting for age and sex, adenoma detection was not associated with provider suboptimal preparation rate ($P = 0.28$).

Conclusions: Rates of suboptimal preparation vary widely between providers, but were not correlated with ADR. This suggests that a high suboptimal preparation rate is not a marker of higher quality standards and expectations by the provider. The impact of physician personality traits on colonoscopy performance requires further study.

Key Words: colonoscopy, mass screening, colorectal neoplasms, quality improvement, bowel preparation

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Colorectal cancer (CRC) remains the third leading cause of cancer death in the United States, and the third most commonly diagnosed cancer, with an overall lifetime risk of

about 5%.¹ Incidence and death rates for CRC have been declining since the 1980s, and this trend has been attributed in part to removal of precancerous polyps as a result of endoscopic screening.² Recent long-term prospective data suggest that colonoscopic polypectomy can reduce CRC mortality by over 50%.³

The success of colonoscopy as a preventative tool depends upon visualization and diligent examination of the entire colon, with accurate identification and removal of neoplastic polyps. Review of patients who develop CRC despite colonoscopic surveillance has shown that over half of interval cancers are preventable and relate to incomplete adenoma detection and removal.⁴ One quality measure of colonoscopic performance, adenoma detection rate (ADR), is defined as the proportion of healthy, asymptomatic patients who have ≥ 1 adenomas detected during screening colonoscopy. Despite current recommendations targeting ADRs of at least 25% for men and 15% for women, wide variability exists in reported rates of adenoma detection.⁵

Both patient and provider factors influence the rate of adenoma detection at colonoscopy. Among patient characteristics, older age, male sex, family history, and smoking status have been shown to be predictive of adenoma detection. There is evidence of wide variation in ADR among endoscopists, which may contribute more to differences in adenoma detection than patient characteristics.⁶ Factors such as endoscopist experience, area of specialization, and withdrawal technique correlate with ADR; however, variations persist among providers even after adjusting for these variables, suggesting that other poorly defined characteristics may contribute.^{7,8}

Studies have shown that suboptimal bowel preparation adversely impacts adenoma detection.^{8–10} It is plausible, then, that poorer quality bowel preparation might contribute to the variation in ADR among providers. By this relationship, one might hypothesize that providers with higher rates of suboptimal bowel preparation would have lower ADRs. In fact, the opposite association has been observed in the one study testing this hypothesis in the area of screening sigmoidoscopy. In that study, endoscopists who graded a higher proportion of their examinations as having poor-quality preparation had a higher ADR, on average, than their colleagues.¹¹ To our knowledge, no such study has been performed in providers performing screening colonoscopy.

Providers have varying standards for declaring preparation suboptimal in clinical practice, which may reflect subtle personal or professional traits. We hypothesized that colonoscopy providers who have higher standards for grading preparation as optimal, and hence higher

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suboptimal preparation rates (SPRs), may be more fastidious in their examination of the colon and, therefore, have higher ADRs. The aim of this study was to determine if such a relationship exists between ratings of bowel preparation and adenoma detection in a cohort of patients who underwent screening colonoscopy.

METHODS

We performed a retrospective review of 1649 patients who underwent screening colonoscopy at Columbia University Medical Center (CUMC). The electronic endoscopy database was queried to identify all patients who underwent colonoscopy during the calendar year 2011. From this sample, patients were included on the basis of the following criteria: their age was 50 years or older, the procedure was indicated for screening purposes, and the quality of the bowel preparation was noted in the report. Patients were excluded if their provider performed fewer than 50 colonoscopies in 2011. Subjects were also excluded if the indication for colonoscopy noted an above-average risk for colorectal neoplasia on the basis of personal or close family history. All colonoscopies that met inclusion criteria were performed directly by attending physicians.

For each examination, the subjective rating of preparation quality was grouped into one of 5 categories: “poor/unsatisfactory,” “fair,” “adequate,” “good,” and “excellent.” Preparations labeled “poor/unsatisfactory,” or “fair,” were considered suboptimal, as has been done previously.^{10,12,13} Each colonoscopist’s SPR was calculated as the number of the provider’s suboptimal examinations divided by the provider’s total number of examinations. A sensitivity analysis was performed with exclusion of “fair” examinations from the numerator of the SPR. As this was a retrospective study, it was not possible to standardize the type of bowel preparation used among different patients or providers. Similarly, the scoring system for preparation quality was not standardized.

Each colonoscopist’s ADR was calculated as the number of examinations with ≥ 1 adenoma divided by the total number of examinations. Adenoma status was determined via cross-referencing each examination with the electronic pathology record. Provider ADR included all of the provider’s screening colonoscopies irrespective of preparation quality. On a sensitivity analysis, providers’ ADR’s were recalculated, now restricted to those examinations with an optimal preparation.

The primary outcome was the correlation between provider SPR and ADR. This was measured using the Pearson correlation coefficient. In addition, multivariate logistic regression was performed to identify independent patient and provider factors associated with adenoma detection. In this model, providers were grouped into quartiles based on procedure volume and SPR. The provider quartile for “poor/unsatisfactory” bowel preparation rating (ie, excluding fair preparations) was run in place of SPR in a separate model. Two-sided *P*-values are reported for all calculations. All statistical calculations were performed using SAS 9.1 (SAS Institute Inc., Cary, NC). The study was approved by the institutional review board of CUMC.

RESULTS

Of 5333 colonoscopies performed during the study period, 1649 examinations by 11 separate gastroenterologists were eligible for inclusion (Fig. 1). The majority (59%) of

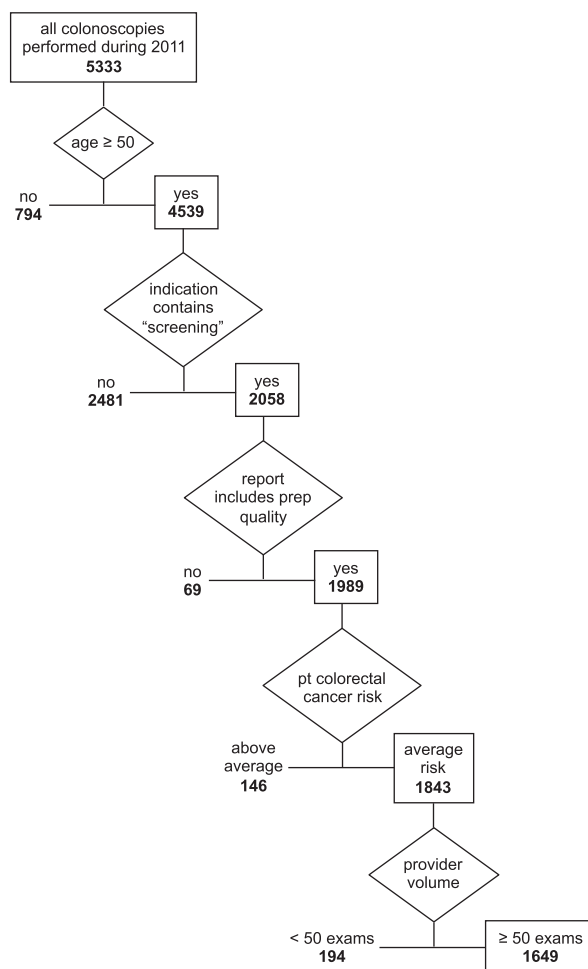


FIGURE 1. Flow diagram of patients who met inclusion criteria for the study.

subjects were female, and the mean age was 61 years (Table 1). Among the 11 providers, procedure volume ranged from 52 to 353 examinations over the study period, with a mean of 150. The cecum was intubated in 98.5% of colonoscopies. The most frequent description of bowel preparation was “good,” comprising 62% of examinations.

The overall rate of suboptimal bowel preparation was 22%, but providers varied in their SPR proportion between 3% and 40% (Table 2). Provider ADR was also highly variable, ranging between 13% and 31%, with a mean of 23%. No significant correlation was observed between SPR and ADR (Pearson coefficient -0.22 , $P = 0.51$). This lack of correlation persisted when redefining SPR so as to be restricted to only poor/unsatisfactory examinations ($r = -0.18$, $P = 0.58$), with exclusion of providers in the highest quartile of SPR ($r = 0.07$, $P = 0.87$) and when recalculating ADR, now limited to optimally prepared examinations ($r = -0.27$, $P = 0.43$). Provider ADR, when restricted to optimally prepared examinations, was 24%, and ranged from 15% to 29%. Three providers with the highest procedure volume performed almost half of all examinations (805, 49%). These high-volume endoscopists did not differ from the remaining 8 providers with regard to average SPR (22% vs. 23%, $P = 0.12$) but did have a

TABLE 1. Patient and Provider Characteristics

	N (%)
Patients (n = 1649)	
Age (y)	
Mean (SD)	61 (8.4)
50-59	769 (47)
60-69	575 (35)
70-79	262 (16)
80 +	43 (3)
Sex	
Female	965 (59)
Male	684 (41)
Bowel prep rating	
Excellent	129 (8)
Good	1018 (62)
Adequate	133 (8)
Fair	298 (18)
Poor/unsatisfactory	71 (4)
Bowel prep adequacy	
Optimal	1280 (78)
Suboptimal	369 (22)
Providers (n = 11)	
Procedure volume (mL)	
Mean (SD)	150 (88)
50-99	3
100-149	5
150-199	0
200 +	3

significantly higher rate of adenoma detection (ADR 25% vs. 20%, *P* = 0.001).

Rates of adenoma detection were higher in male patients (27% vs. 20%, *P* = 0.0005) and in older patients (37% in ≥ 80 y vs. 19% in 50-59 y, *P* = 0.003, Table 3). There was a trend toward lower adenoma detection in patients with suboptimal preparation (19.5% vs. 23.5%, *P* = 0.10). Although providers in the highest quartile for declaring preparations suboptimal found fewer adenomas (18%) compared with providers in the lowest quartile for declaring preparations suboptimal (23%), the trend was not significant (*P* = 0.19).

TABLE 2. Procedure Volume, Suboptimal Preparation Rate (SPR), and Adenoma Detection Rate (ADR), With Correlation Coefficients

	Procedure Volume (N)	SPR (%)	ADR (%)	ADR for Optimal Examinations (%)
Total	1649	22	23	24
Provider				
A	353	28	24	24
B	230	9	26	26
C	222	25	23	29
D	143	3	25	27
E	139	38	23	23
F	127	8	13	15
G	126	40	14	15
H	114	22	31	29
I	88	32	17	15
J	55	22	16	16
K	52	21	17	22
Correlation coefficient*	-0.03	1	-0.22	-0.27
	<i>P</i> = 0.94		<i>P</i> = 0.51	<i>P</i> = 0.43

*Correlation coefficients and *P*-values calculated with respect to SPR using the Pearson correlation coefficient.

TABLE 3. Univariate Analysis of Factors Associated With Adenoma Detection

	Adenomas [N (%)]	<i>P</i> -value*
Sex		
Female	189 (19.6)	0.0005
Male	184 (26.9)	
Age (y)		
50-59	146 (19.0)	0.003
60-69	144 (25.0)	
70-79	67 (25.6)	
80 +	16 (37.2)	
Bowel prep adequacy		
Optimal	301 (23.5)	0.10
Suboptimal	72 (19.5)	
Family history		
No	338 (22.6)	0.90
Yes	35 (23.0)	
Provider SPR quartile		
Q1	115 (23.0)	0.19
Q2	54 (24.4)	
Q3	139 (24.2)	
Q4	65 (18.4)	

**P*-values calculated using χ^2 test for proportions.

On multivariate analysis (Fig. 2), adenoma detection was associated with male sex [odds ratio (OR) = 1.55; 95% confidence interval (CI), 1.23-1.97] and older age (OR, 2.58 for ≥ 80 vs. 50-59; 95% CI, 1.35-4.95). After adjusting for age and sex, the association between suboptimal preparation and decreased adenoma detection did not meet statistical significance (OR, 0.78; 95% CI, 0.72-1.62). Among provider factors included in the model, the quartile for SPR frequency—how often a provider declared preparation to be suboptimal, defined as “poor/unsatisfactory” or “fair”—remained independent of adenoma detection (*P* = 0.28). As a sensitivity analysis, a separate logistic regression was performed with exclusion of “fair” examinations. In this scenario, providers who more frequently declared preparation to be “poor/unsatisfactory” indeed detected fewer adenomas, with an odds ratio of 0.50 for providers in the third versus first quartiles (95% CI, 0.34-0.72), but this effect was less prominent and not statistically significant for the providers in the highest SPR quartile. Provider quartile for procedure volume was predictive of adenoma detection, with endoscopists who performed more colonoscopies having higher ADR (OR, 1.59 for quartile 4 vs. quartile 1; 95% CI, 1.05-2.42).

DISCUSSION

Colonoscopy and polypectomy are complex, technically demanding procedures that are operator-dependent, with wide variations in performance between providers.^{6,14,15} The significance of ADR was validated in a study of 186 endoscopists in which provider ADR was shown to be associated with the risk of interval development of CRC (hazard ratio = 10.9 for provider ADR from 15% to 19% vs. ADR ≥ 20%).¹⁶ Despite clear evidence of its importance, patients are seldom aware of how significant the impact of endoscopist performance is on the likelihood of detection and prevention of a colorectal neoplasm.

In this study, we found wide variation in ADR among providers, ranging from 13% to 31%. These rates of adenoma detection are remarkably consistent with prior studies

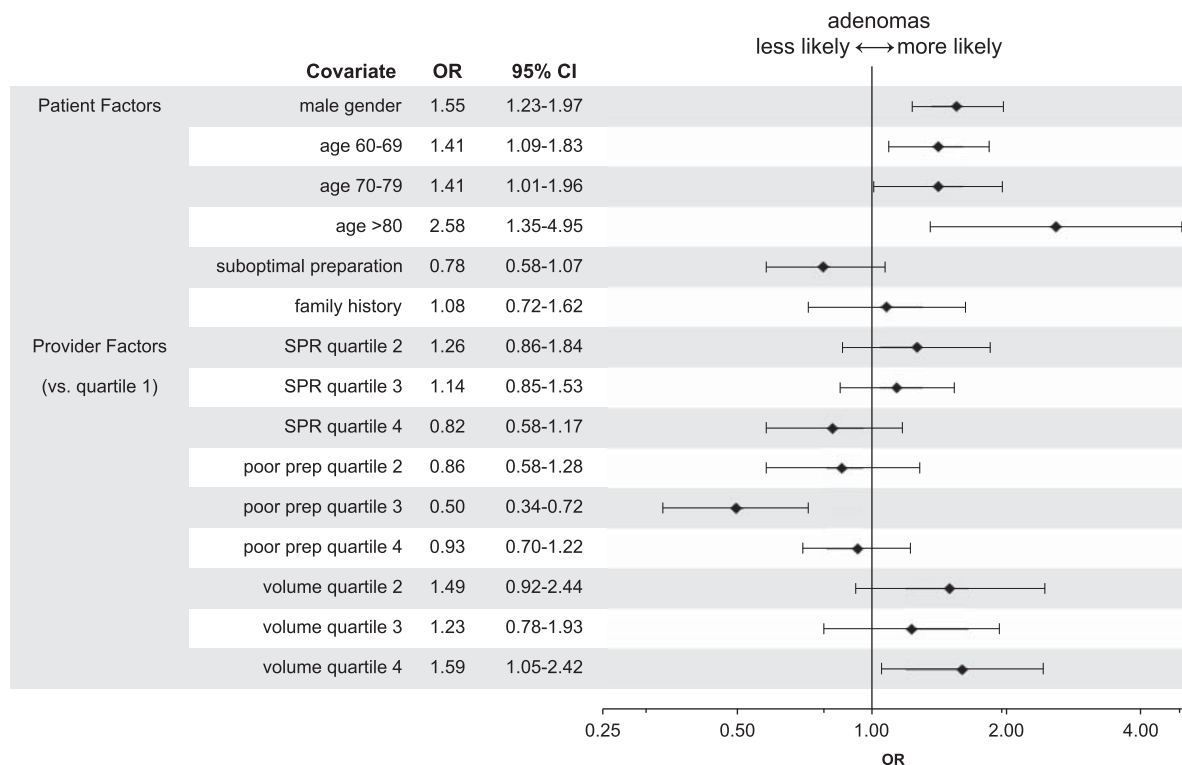


FIGURE 2. Forest plot: factors associated with adenoma detection on multivariate analysis. SPR indicates suboptimal preparation rate.

in similar cohorts, both in average value and range.^{17,18} We found an association between procedure volume and ADR, with higher volume endoscopists detecting adenomas with greater frequency. These findings suggest that variation among providers is in part attributable to skills reinforced by frequent performance and/or overall experience. The literature is, however, inconsistent on the impact of case volume on ADR. Adler et al⁸ found no association between ADR and a provider’s annual or lifetime case volume in a prospective study of 12,134 colonoscopies. Another study found the relationship between procedure volume and polypectomy rates followed a U-shaped curve, in which providers of mid-range volume had higher rates than those at the extremes.¹⁹

The proportion of colonoscopy preparations rated as suboptimal—defined as “poor,” “unsatisfactory,” or “fair”—varied widely among providers in this study. The reason for such large variations in SPR between providers is not entirely clear. The grading of bowel preparation is inherently subjective, and the lack of standardization of how preparation was scored in our study added to this variability. The overall rate of suboptimal preparation, at 22%, is consistent with prior reports of 20% to 25%.^{10,20}

We hypothesized that provider differences in preparation grading would correlate with differences in adenoma detection, as reported by Thomas-Gibson et al¹¹ of the UK Flexible Sigmoidoscopy Screening Trial (UKFSST). No such correlation was observed in our study. Although providers in the second-highest quartile for declaring preparation “poor/unsatisfactory” detected fewer adenomas than those in the lowest quartile (Fig. 2), the relationship did not persist for those in the highest quartile, and it is unclear how to interpret this isolated result. There are several possible reasons why our results diverge from those prior. One relates to a significant

limitation: retrospective design. The UKFSST was carried out prospectively, allowing for standardization of bowel preparation administration and preparation scoring protocol. The former trial independently evaluated trial endoscopists’ standards for bowel preparation grading by reviewing the examinations with trained video scorers. All patients who were deemed to have poor preparation required a repeat examination. The retrospective nature of our study precluded standardization of any of these factors: the type of bowel preparation used, the manner in which preparation quality was scored, or the consequences of poor preparation. These issues limit the interpretability of the wide differences in SPR among providers. Differences in SPR may be driven in part by differences in patient characteristics between physicians. However, given the very large range of SPRs between providers, the variation is unlikely to stem predominantly from differences in patient characteristics in this single-center study, and subjective differences in the way endoscopists reported preparation quality are likely a significant contributor.

Other limitations include a single-center design, which reduces generalizability, and a relatively small sample size of patients (although in terms of provider volume it is comparable to prior trials including the UKFSST). The retrospective design limited inclusion of colonoscopy withdrawal time, which was not routinely recorded at the time of our analysis. Withdrawal time would ideally have been included as a covariate; however, we feel it is unlikely to represent a significant confounding factor limiting our ability to detect a relationship between SPR and ADR. A further limitation involves lack of information on socio-demographic heterogeneity among different providers’ patient cohorts, which may impact the risk of colorectal neoplasia as well as the risk of suboptimal preparation.

In conclusion, we found that providers range widely with regard to SPR, similar to wide variation in provider ADR; however, there was no correlation between these 2 measures. Although suboptimal preparation adversely impacts adenoma detection, a provider's self-reported rate of suboptimally prepared examinations does not predict his/her ADR. The results of this study underscore the marked variations that persist in endoscopist performance. The differences seen here in rates of adenoma detection may directly impact upon the risk of interval cancer development in screened patients. As yet undefined factors—including personal and professional traits—likely contribute to both ADR and SPR. Further study is needed to characterize such provider factors so that attempts can be made to optimize delivery of this valuable and powerful tool for cancer prevention.

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