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# Relationship between Detection of Adenomas by Flexible Sigmoidoscopy and Interval Distal Colorectal Cancer

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## Abstract

**Background & Aims—**Low rates of adenoma detection by colonoscopy have been associated with increased rates of interval colorectal cancer. We evaluated the relationship between the rate of adenoma detection by flexible sigmoidoscopy and interval, distal colorectal cancer.

**Methods—**We analyzed data from the Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer screening trial, which used flexible sigmoidoscopy as a colorectal cancer screening modality (46,835 subjects, 66,711 examinations by 93 examiners). An adenoma detection rate was defined for each examiner as the number of exams that identified adenomas (confirmed by pathology analysis) divided by the total number of screening exams. Interval cancers were defined as cancers presumed detectable but not detected, based on the stage at diagnosis and the elapsed time from screening to diagnosis.

**Results—**The PLCO study identified 32 distal interval cancers. The incidence of interval cancer for individuals screened by examiners in the lowest quartile of distal adenoma detection (2.0%–7.2%) was 9.0/10,000 examinations, whereas the incidence of interval cancers was lower among individuals whose examiners were in higher quartiles of adenoma detection, ranging from 3.0-5.4/10,000 exams. The odds of distal interval cancer were significantly increased for patients of examiners in the lowest quartile of distal adenoma detection (<7.2%) with an adjusted odds ratio of 2.4 (95% confidence interval [CI], 1.1–5.0; $P$=.02).

**Conclusions—**Lower levels of adenoma detection by flexible sigmoidoscopy increase the risk for distal, interval cancer. Detection of distal adenomas is a marker of the performance quality of flexible sigmoidoscopy. The parent study is registered under ClinicalTrials.gov, number NCT00002540.



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**Clinical Trial Information:** This is an analysis of data collected as part of the PLCO Trial. This trial is registered under the following name: Protocol for the NCI Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial and was registered 11/16/1993 in ClinicalTrials.gov under NCT00002540.

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**Author Contributions:** Shari Rogal: assistance with analytic plan, interpretation of data, drafting/revision of the manuscript Paul Pinsky: study concept and design, analysis and interpretation, manuscript revision Robert Schoen: study concept and design, acquisition and interpretation of data, manuscript revision

**Keywords**

sigmoidoscopy quality; adenoma detection rate; colorectal cancer prevention; epidemiology

## Introduction

The adenoma detection rate (ADR) at colonoscopy varies by endoscopist[1-4], and is associated with patient outcome. In the National Colorectal Cancer Screening Program in Poland[5], endoscopists with ADRs of <20% had significantly higher rates (hazard ratio of 10-12 fold) of subsequent interval colorectal cancer (CRC) than endoscopists with ADRs ≥20%. The implication is that endoscopists with low ADRs are prone to leaving adenomas in situ, which can subsequently evolve into cancer. In this study the median ADR for colonoscopy was 12.2% with a range of <11% to >20%. A minimum ADR of 15% in women and 25% in men at screening colonoscopy is recommended[4].

Like colonoscopists, flexible sigmoidoscopy (FSG) examiners also have a wide range of polyp and adenoma detection. In the PLCO trial, among 64 examiners, all with 100 or more FSG exams, the polyp detection or screen positive rate ranged from 9 - 58%, and the ADR from 4 - 15% [6]. A study of 13 endoscopists in the UK Flexible Sigmoidoscopy Screening Trial found a polyp detection rate ranging from 15.6-41.9% and ADRs ranging from 8.6-15.9%, with a median rate of 11.8% [7]. In the UK trial, adjustment for local cancer incidence, patient characteristics, and examiner specialty did not account for these differences, which were attributed to variability in sigmoidoscopy performance. We evaluated the relationships between polyp detection rates and proximal, distal, and overall ADR at FSG and subsequent distal CRC.

## Methods

This analysis was conducted among participants and examiners in the Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer screening trial of FSG[8-9]. Participants were randomized to cancer screening with a 60cm FSG versus usual care. Nearly 155,000 people were enrolled in 10 centers between November 1993 and July 2001. Screening centers obtained participants' informed consent and local institutional review board approval. Recruitment was done primarily by mail and included men and women between 55 and 74 years of age who were not undergoing cancer treatment (other than skin cancer) and had no known prior history of a PLCO cancer. Beginning in 1995, participants were required to have had no colonoscopy, sigmoidoscopy, or barium enema in the previous 3 years. FSG was initially offered at baseline and 3 years, though a protocol modification in 1995 changed the follow-up interval to 5 years. A questionnaire was used to obtain baseline characteristics, family history of CRC in first degree relatives, and history of fecal occult blood testing (FOBT) or lower GI endoscopy in the 3 years prior to enrollment. A detailed description of the cancers in the sigmoidoscopy screening arm of the study was recently published[10].

Examiners were certified practitioners of FSG who followed standardized procedures to perform and record results of a 60-cm FSG. Examinations were categorized by depth of insertion, adequacy of bowel preparation, and visual findings. An inadequate exam included insertion <50cm or inspection limited to <90% of the mucosal surface due to inadequate bowel preparation. A negative exam included ≥50cm insertion without detection of a polyp or mass. A positive screening test was defined as detection of any mass or polyp, regardless of exam adequacy. Participants with positive screening tests were referred to their primary care physicians for decisions regarding diagnostic follow-up. Of subjects with an abnormal screen, 80.5% underwent diagnostic intervention within 1 year, over 95.6% of which

underwent colonoscopy[8-9]. The trial tracked participants for at least 12 months after screening to determine the results of subsequent diagnostic testing.

Interval cancer was defined as a lesion that was prevalent but not detected at the time of screening. We confined our analysis to interval cancers that followed a screening FSG with no polyps or masses. Medical records underwent standardized review to categorize CRCs using the AJCC Cancer Staging Model[11]. Screen detected cancers were defined as CRCs diagnosed within 1 year of a positive screening exam. Stage I or II CRC detected >30 months or stage III or IV CRC detected >48 months from the time of screening was defined as "undetectable" at the time of screening[10]. Lesions were considered prevalent but not detected at screening (i.e. interval) if they were stage I or II and found within 30 months or if they were stage III or IV and detected within 48 months after a negative screening exam. We excluded interval cancers attributable to other factors such as inadequate preparation, delayed follow up colonoscopy, inadequate depth of insertion at sigmoidoscopy, or lesions missed at subsequent colonoscopy[10]. Subjects with tumors following inadequate exams due to inadequate preparation or depth of insertion were not included in this analysis because interval cancers in that setting were presumably unrelated to provider performance. For those with more than one screening exam, the cancer was defined in relation to the most recent exam. A sensitivity analysis that adjusted the assumptions used in defining the timing of interval cancers found the definition employed to be robust. This included expanding the timing that defined a cancer as detectable up to 5 years for advanced stage disease and up to 42 months for early stage disease[10]. Cancers occurring during the course of the trial not linked to screening were ascertained primarily by a mailed annual study update questionnaire. Repeated mailings and telephone calls were used to ensure response, which was 93.8% overall.

For each endoscopist with ≥100 exams, we calculated raw and adjusted polyp and adenoma detection rates using intervention arm subjects. The 100-exam minimum was utilized to ensure a stable rate for analysis. Polyp detection rate was calculated by dividing the number of positive screening exams by the number of total exams completed by each practitioner. The raw ADRs by practitioner were calculated by dividing the number of examined subjects with adenomas on follow-up colonoscopy by the total number of screening exams. An adjusted ADR was calculated to achieve a better measure of the endoscopists' underlying detection rate by controlling for differences in patient age at the exam, gender, and completion of subsequent colonoscopic follow-up. The adjusted rate was calculated by averaging adenoma detection in four groups (men ≥ 65, men < 65, women ≥ 65 and women < 65) for each examiner and dividing the gender and age-averaged ADR by the examiner-specific rate at which patients with a positive screen (detection of a polyp) received colonoscopic follow-up. These adjustments were performed for overall, proximal, and distal ADRs for each examiner. Proximal adenomas were defined as those proximal to the splenic flexure and distal adenomas were defined as those distal to the splenic flexure. For those with multiple exams, the age at each exam was used for analysis. We also computed an adjusted polyp detection rate by evaluating the gender and age adjusted rates of screen positive exams (number of positive screens over number of exams), which included polyps detected by FSG and did not require pathologic identification of an adenoma at subsequent colonoscopy. Of note, the polyp detection rate is based on the flexible sigmoidoscopist defining a lesion at FSG while ADR is based on pathological confirmation of an adenoma on further exam and is thus dependent on adherence to colonoscopic follow-up and the skill of the colonoscopist at detecting adenomatous lesions.

The rate of interval cancer was calculated by dividing the number of interval cancers by the number of negative exams, because an "interval" cancer could only follow a negative screening exam with no polyp or mass detected. For a negative exam to be included in the

denominator, there had to have been follow-up for cancer incidence for at least one year from the time of the negative exam. If a subject had two negative exams but only one was performed by an examiner with ≥ 100 exams, then only that exam was used in the analysis.

### Statistics

Among eligible examiners, adjusted polyp detection rates and ADRs (overall, proximal, and distal) were calculated. Medians, ranges, and interquartile ranges were determined. Pearson correlation coefficients between the different rates were assessed. Examiners were divided into quartiles by their ADRs and polyp detection rates. The interval cancer rate for each quartile of examiner rates was then calculated. The number of eligible exams in each quartile varied because the quartiles were established by examiners' detection rates rather than number of exams. Eligible exams included subjects with negative exams with ≥1 year follow-up, completed by eligible examiners.

We used mixed effects multiple logistic regression models to examine the relationship between interval cancers and endoscopists' adjusted polyp and adenoma detection rates, controlling for possible confounding covariates. The covariates included age of subject at a given exam, sex of subject, study year of exam (baseline or year 3 or 5), examiner type (gastroenterologist vs. other), history of endoscopy and history of FOBT in the 3 years prior to enrollment, and family history of CRC. The unit of analysis in the regression models was screening exam and interval cancer was the outcome. One model was developed for each of the following adjusted rates: ADR, distal ADR, proximal ADR, and polyp detection rate, each with the same covariates. The correlation between the risks from repeated exams was accounted for by specifying the subject as a random effect in the mixed-effects model. The adjusted ADR, covariates, and study year were modeled as fixed effects. In an attempt to find a cut-point for ADR, as suggested in prior literature, the overall ADR was dichotomized to <10% vs. ≥10% in order to assess for differences in interval cancer rates.

We used a simulation approach to perform a retrospective power analysis. Based on the continuous logistic regression model, we examined the power of the study under varying assumptions about the true odds ratio for a difference in examiner rates equal to that of the interquartile range. All authors had access to the study data and reviewed and approved the final manuscript.

## Results

Figure 1 demonstrates the overall flow of participants in the PLCO trial. A total of 77,445 subjects were enrolled in the intervention arm of PLCO. Of these, 67,072 underwent at least one exam, and 46,835 were at risk for interval cancer by meeting the eligibility criteria of having a negative exam performed by an eligible examiner with at least one year follow-up. 98.9% of subjects were followed for ≥30 months and 97.3% for ≥48 months. These 46,835 subjects had a total of 66,711 eligible exams, of which 40,794 were at baseline, 8,342 at year 3 and 17,575 at year 5. There were 32 distal interval cancers among eligible subjects examined by eligible examiners.

The baseline characteristics of all intervention arm subjects were similar to subjects eligible for analysis in this study (Table 1). Of eligible subjects, 52% were male, 71% were under the age of 65, and 9.9% had a family history of cancer, defined as a first degree relative with colorectal cancer. Within 3 years prior to enrollment, 13% had a lower endoscopy and 40% had an FOBT. The 32 subjects with interval cancer tended to be older than eligible subjects (44% were age 65-74 vs. 29% of eligible subjects, p=0.07) with a family history of CRC (19% vs. 9.9%, p=0.09), though these differences were non-significant.

Of the 177 examiners in the PLCO trial, 93 performed ≥100 exams; these 93 accounted for 97% of all FSG exams in the trial. Practitioners included 34 gastroenterologists, 34 nurse practitioners, 7 gastroenterology fellows, 2 physicians of other specialties, and 16 practitioners of unreported specialty. Of 66,711 exams, 60.4% were completed by a nurse practitioner, 22.6% by a gastroenterologist, 8.9% by a gastroenterology fellow, 0.5% by a physician in another specialty, and 7.7% by practitioners of unreported specialty. Among eligible examiners, the median raw rate of adenoma detection varied by gender (11.7% for men and 6.3% for women, $p < 0.0001$) and was higher in the older age group (ages 65-74 compared to 55-64) (10.1% vs. 8.4%, $p < 0.0001$). Median overall raw rates among eligible examiners were 9.1% for any adenoma, 6.9% for distal adenomas, and 3.3% for proximal adenomas; the median polyp detection rate was 25.7%.

Adjusted polyp and ADRs (overall, distal, proximal) were positively correlated with each other, with correlation coefficients ranging from 0.5 for the proximal and distal ADRs up to 0.87 for the distal and overall ADRs (Table 2). The adjusted polyp detection rate and ADR were highly correlated with a correlation coefficient of 0.81.

Number of interval cancers and interval cancer rate per 10,000 exams qualitatively tracked with examiners' adjusted adenoma and polyp detection rates (Table 3). As detection rates increased, interval cancer rates decreased. The interval cancer rate for examiners in the lowest quartile of ADR (3.6-9.3%) was 7.5/10,000 exams, while interval cancer rates were lower for those in higher quartiles of ADR, ranging from 2.6-5.7/10,000 exams. Similarly, examiners in the lowest quartile of polyp detection (6.1-17.9%) had an interval cancer rate of 6.0/10,000 compared to 2.5-5.1/10,000 for those with higher polyp detection rates. For the distal ADR, the lowest quartile of detection (2.0-7.2%) had an interval cancer rate of 9/10,000 compared to a rate of 3.0-5.4/10,000 among higher quartiles.

Table 4 shows the results of the adjusted odds ratios of interval cancer by examiner detection, controlling for age, gender, examiner type, history of endoscopy, and family history of CRC from logistic regression models. None of the covariates were significantly associated with interval cancer rates, though family history (OR=2.1, p=0.09) and age ≥ 65 (OR=1.9, p=0.07) trended toward significance. The odds of interval cancer were significantly increased for patients of examiners in the lowest quartile of distal adenoma detection (≤7.2%) compared to all other quartiles, with an adjusted odds ratio of 2.4 (95%CI 1.1-5.0, p=0.02). There were similar trends toward significance for the comparisons of the lowest quartile of proximal and overall adenoma detection rates compared to all other quartiles combined (OR=1.8, p=0.10 and OR=2.0, p=0.06, respectively). Comparison of the lowest to the highest quartile of examiner adenoma and polyp detection rate demonstrated non-statistically significant tendencies toward increased cancer risk in the lowest quartile of detection for all categories, although the confidence intervals were wide. When dichotomized to a 10% cut-point for adjusted ADR, the interval cancer rates were 5.5/10,000 for below 10% and 4.4/10,000 for above 10% (p=0.53).

Power estimates were performed for examiners' adenoma and polyp detection rates for a true OR of 2.0, 1.7, and 1.4, which had associated powers of 78%, 57%, and 36% respectively for ADR, calculated based on a continuous model and corresponding to a difference in rates equal to the interquartile range. For the polyp detection rate, power was 89%, 66% and 39% for ORs of 2.0, 1.7, and 1.4, respectively. The simulations matched the event rate and covariate distribution of the actual population.

## Discussion

In a study of screening colonoscopy in Poland, ADR was validated as a measure of colonoscopy performance quality, as low ADRs were associated with subsequent interval colorectal cancer[5]. This is the first study to examine flexible sigmoidoscopy adenoma and polyp detection rates in relation to subsequent distal, interval colorectal cancer. Adenoma detection rates varied as they have in other studies of FSG[7], with the adjusted ADR ranging from 3.6 to 24.5% and the adjusted polyp detection rate ranging from 6.1 to 62.6%. Qualitatively, examiners with low polyp and adenoma detection rates had higher rates of interval cancer. Patients of examiners in the lowest quartile of distal adenoma detection (<7.3%) had over a two-fold statistically significant increased risk of interval distal cancer. Our study provides additional validation for the use of the ADR as a quality indicator of endoscopic procedures. The association of low detection rates with increased risk of interval cancer emphasizes the importance of measuring and monitoring ADRs among endoscopists.

Though colonoscopic withdrawal time over 6 minutes has been associated with a higher ADR in comparison to a shorter withdrawal time[3], the withdrawal time does not necessarily correlate with the ADR. Despite fairly uniform withdrawal time among 6 endoscopists in one study, the ADR ranged from 14.2 to 27.4%[12]. Rather than a process measure such as withdrawal time [13], it is the outcome measure or ADR that correlates best to important clinical parameters such as subsequent interval cancer. Novel methods to facilitate measurement of adenoma detection on a large scale are needed and are being pursued as a means to improve the quality of practice[14-15].

Our investigation has several limitations. The number of subjects with interval cancer, the primary outcome, was small, limiting the study power and precluding identification of threshold levels for increased risk, despite our having included over 90 examiners, over 46,000 subjects and over 66,000 exams. The study of ADR at colonoscopy[5], with similar sample size, also had limited power and wide confidence intervals. The definition of interval cancer was based on stage at diagnosis in relation to the time of screening. Cancers are biologically variable however, and our assumptions about whether a cancer may have been detectable and hence preventable at the time of screening may not universally apply. Finally, the colonoscopists who performed the exams for follow-up of an abnormal FSG screen were not the same examiners who performed the FSG, so the ADRs were also dependent on the colonoscopy examiners and not solely on the sigmoidoscopy examiners, who are the focus of this investigation.

Several potential measures were assessed as quality indicators in this study including ADR, polyp detection rate, and proximal and distal ADR. Adenoma detection was highly correlated with polyp detection. The polyp detection rates were the screen positive rates for the FSG examiners, but they do not necessarily reflect the findings on colonoscopy. In the PLCO trial, 20% of those with positive screening FSGs had no distal lesions seen on colonoscopy and 10% had a normal colonoscopy[16]. The screen positive or polyp detection rate at FSG is a parameter attributable to the FSG examiner alone. Using polyp detection rate as a measure of FSG quality, rather than ADR avoids the need for obtaining pathology confirmation of FSG findings. This is useful in situations where FSG does not include biopsy. However, we could not identify a statistical threshold in polyp detection rate that was significantly associated with increased rate of interval cancer due to limited statistical power. Because only 32 cases of interval cancer were identified, we had only 39% power to detect a significant association between polyp detection rate and interval cancer with an OR=1.5.

While no clear cutoff rate could be identified as ideal in terms of minimizing interval cancer risk, it appeared that higher detection rates were associated with lower rates of interval cancer. We tested whether an ADR of 10% , as suggested by Atkin et al.[7] led to a difference in outcome and found only a slight and non-significant increased cancer risk with an ADR cut-point of 10%. There was not a linear relationship between raw interval cancer rates and practitioner ADRs, however, as was also observed in the study of colonoscopy and adenoma detection in Poland[5]. Of note, while the colonoscopy compared each quartile to the highest quartile of ADR in regression models, for reasons of power we compared the lowest detection group against all other quartiles combined, as a proof of concept that low ADRs are associated with a higher risk of interval cancer. Our analysis suggests that with low levels of detection there is an increased risk of interval cancer, as the lowest quartile of adenoma and polyp detection was associated with the highest rate of interval cancer. Extremely high rates of polyp detection at sigmoidoscopy however, might lead to increased morbidity from a high false positive rate. Furthermore, extremely high ADRs may not necessarily enhance prevention of cancer. When very high ADRs are observed, this typically indicates that diminutive adenomas are being detected, and these adenomas are unlikely to result in malignancy[4]. Some investigators advocate removing small polyps, but not obtaining pathology[17].

In conclusion, the lowest quartile rate of distal ADR was associated with significantly increased odds of interval cancer. The distal ADR may be the most accurate representation of performance of FSG since it represents the finding of neoplasia in the examined colonic segment. The highest risk of interval cancer was among patients of endoscopists whose distal ADR at FSG was <7.3%. Thus, a low distal ADR at flexible sigmoidoscopy is associated with increased risk of subsequent distal colorectal cancer. The distal ADR is a marker of flexible sigmoidoscopy performance quality.

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## Abbreviations

| | |
|---|---|
| **ADR** | adenoma detection rate |
| **CRC** | colorectal cancer |
| **FSG** | flexible sigmoidoscopy |
| **PLCO** | Prostate, Lung, Colorectal, and Ovarian |

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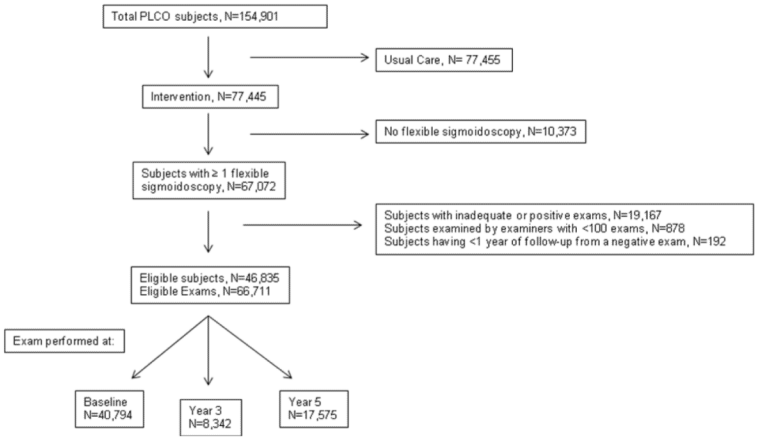


**Figure 1.**
PLCO subjects and exams

## Table 1

Baseline characteristics of intervention arm, eligible, and interval cancer subjects

| | Intervention arm subjects (N=77,445) N (%) | Eligible subjects[†] (N=46,835) N (%) | Interval Cancer[‡] (N=32) N (%) |
|---|---|---|---|
| Male | 38,335 (49.5) | 24,354 (52.0) | 16 (50.0) |
| Female | 39,110 (50.5) | 22,481 (48.0) | 16 (50.0) |
| Age (at baseline) | | | |
| 55-64 | 49,642 (64.1) | 33,253 (71.0) | 18 (56.0) |
| 65-74 | 27,803 (35.9) | 13,582 (29.0) | 14 (44.0) |
| Family History of CRC[§] | 7,899 (10.2) | 4,637 (9.9) | 6 (19.0) |
| History of endoscopy[¶] in the 3 years prior to enrollment in trial | 9,913 (12.8) | 6,182 (13.2) | 5 (16.0) |
| History of FOBT in the 3 years prior to enrollment in trial | 29,971 (38.7) | 18,593 (39.7) | 13 (40.7) |

[†] Eligible subjects include those with negative screening exams, completion of exams by a practitioner with ≥100 exams, and ≥ 1 year of follow-up after a negative exam.

[‡] Interval cancers are among eligible subjects

[§] In a first degree relative

[¶] FSG or colonoscopy

## Table 2

Adjusted polyp and adenoma detection rates[†]

| | Polyp detection Rate[‡] (%) | Adenoma Detection Rate[§] (%) | Distal Adenoma Detection Rate[§] (%) | Proximal Adenoma Detection Rate[§] (%) |
|---|---|---|---|---|
| Median | 24.4 | 12.2 | 9.2 | 4.3 |
| ($25^{th}$,$75^{th}$ percentile) | 18.0,31.5 | 9.4,14.4 | 7.3,11.2 | 3.2,5.9 |
| Range | 6.1-62.6 | 3.6-24.5 | 2.0-15.8 | 1.0-11.7 |
| Correlation with Adenoma Detection Rate | 0.81 | - | 0.87 | 0.77 |
| Correlation with Distal Adenoma Detection Rate | 0.58 | | - | 0.50 |
| Correlation with Proximal Adenoma Detection Rate | 0.72 | | | |

[†]Includes examiners with ≥100 examinations (N=93)

[‡]Adjusted for gender and age

[§]Adjusted for gender, age, and diagnostic follow-up rates for screening exams in which a polyp was identified

## Table 3

Relationship between the adjusted adenoma and polyp detection rate and interval cancer

| Quartile of Examiners' Rates (% detected) | Number of Cancers | Number of Exams Among Eligible Subjects† | Interval Cancer Rate (per 10,000 exams) |
|---|---|---|---|
| Quartile of Adjusted Adenoma Detection Rate | | | |
| 1st (3.6-9.3) | 13 | 17,361 | 7.5 |
| 2nd (9.4-12.1) | 8 | 23,957 | 3.3 |
| 3rd (12.2-14.3) | 8 | 13,947 | 5.7 |
| 4th (14.4-24.5) | 3 | 11,446 | 2.6 |
| Quartile of Adjusted Distal Adenoma Detection Rate | | | |
| 1st (2.0-7.2) | 11 | 12,260 | 9.0 |
| 2nd (7.3-9.1) | 8 | 26,291 | 3.0 |
| 3rd (9.2-11.1) | 7 | 12,883 | 5.4 |
| 4th (11.2-15.8) | 6 | 15,277 | 3.9 |
| Quartile of Adjusted Proximal Adenoma Detection Rate | | | |
| 1st (1.0-3.1) | 14 | 20,436 | 6.9 |
| 2nd(3.2-4.2) | 8 | 21,241 | 3.8 |
| 3rd (4.3-5.8) | 7 | 16,267 | 4.3 |
| 4th (5.9-11.7) | 3 | 8,767 | 3.4 |
| Quartile of Adjusted Polyp Detection Rate | | | |
| 1st (6.1-17.9) | 15 | 24,922 | 6.0 |
| 2nd (18.0-24.3) | 11 | 21,591 | 5.1 |
| 3rd (24.4-31.4) | 2 | 8,085 | 2.5 |
| 4th (31.5-62.6) | 4 | 12,113 | 3.3 |

† The number of exams are not equal across quartiles because quartiles reflect the distribution of adenoma and polyp detection rates amongst examiners, and examiners' performed varying numbers of exams

## Table 4

Logistic Regression of interval cancer by examiner detection rates

| | OR (95% CI) | P value |
|---|---|---|
| **Examiner Categorical Rates (1st quartile vs 2nd thru 4th quartile)** | | |
| Adenoma Detection Rate ≠ | 2.0 (0.98-4.0) | 0.06 |
| Distal Adenoma Detection Rate | 2.4 (1.1-5.0) | 0.02 * |
| Proximal Adenoma Detection Rate | 1.8 (0.9-3.8) | 0.10 |
| Polyp detection Rate | 1.6 (0.8-3.2) | 0.22 |
| **Examiner Categorical Rates (1st vs. 4th quartile)** | | |
| Adenoma Detection Rate | 3.3 (0.8-12.9) | 0.09 |
| Distal Adenoma Detection Rate | 2.5 (0.9- 7.2) | 0.08 |
| Proximal Adenoma Detection Rate | 2.7 (0.7-10.0) | 0.13 |
| Polyp Detection Rate | 2.1 (0.5-5.8) | 0.20 |
| **Covariates** † | | |
| Male | 1.2 (0.6-2.4) | 0.67 |
| Age ≥65 | 1.9 (0.9-3.4) | 0.07 |
| History of Endoscopy in 3 years prior to enrollment | 1.0 (0.4-2.5) | 0.93 |
| Family History of CRC | 2.1 (0.9-5.1) | 0.09 |
| Examiner Type ** | 0.6 (0.2-1.6) | 0.28 |

† ORs for covariates are based on the model of adenoma detection rate comparing the 1st quartile vs. 2nd thru 4th quartile.

≠ For the entire colon

* p<0.05

** Gastroenterologist vs. other