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Endoscopist Adenoma Per Colonoscopy Detection Rates and Risk for Post Colonoscopy Colorectal Cancer: Data From New Hampshire Colonoscopy Registry

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Abstract

Background and Aims—Adenomas per colonoscopy (APC) may be a better measure of colonoscopy quality than adenoma detection rate (ADR) since it credits endoscopists for each detected adenoma. There are few data examining the association between APC and post colonoscopy colorectal cancer (PCCRC) incidence. We used data from the New Hampshire Colonoscopy Registry (NHCR) to examine APC and PCCRC risk.

Methods—We included NHCR patients with an index exam and at least one follow up event, either a colonoscopy or a CRC diagnosis. Our outcome was PCCRC defined as any CRC

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diagnosed ≥ 6 months after an index exam. The exposure variable was endoscopist specific APC quintiles of 0.25, 0.40, 50 and 0.70. Cox regression was used to model the hazard of PCCRC on APC, controlling for age, sex, year of index exam, index findings, bowel preparation and having more than 1 surveillance exam.

Results—In 32,535 patients, a lower hazard for PCCRC (n=178) was observed for higher APCs as compared to APCs <0.25 (Reference) (0.25-<0.40:HR=0.35, 95% CI: 0.22–0.56;0.40-<0.50: HR=0.31, 95% CI: 0.20–0.49; 0.50-<0.70: HR=0.20, 95% CI: 0.11–0.36; and ≥0.70: HR=0.19, 95% CI: 0.09–0.37). When examining endoscopists with an ADR of at least 25%, an APC < 0.50 was associated with a significantly higher hazard than an APC ≥ 0.50 (HR=1.65; 95% CI: 1.06–2.56). A large proportion of endoscopists, 1/5th (32/152; 21.1%), had an ADR ≥25 but an APC <0.50.

Discussion—Our novel data demonstrating lower PCCRC risk in exams performed by endoscopists with higher APCs suggest that APC could be a useful quality measure. Quality improvement programs may identify important deficiencies in endoscopist detection performance by measuring APC for endoscopists with ADR ≥ 25%.

Keywords

adenoma; colonoscopy; detection

Introduction

The adenoma detection rate (ADR) is an endoscopist-specific quality measure which is calculated by dividing the number of complete screening colonoscopies with adequate bowel preparation where at least one adenoma is detected by the total number of complete screening colonoscopies with adequate bowel prep.[1, 2] A higher ADR for the endoscopist performing a colonoscopy has been shown to reduce the risk for future colorectal cancer (CRC) in the patient having the exam.[3–5] The current national guideline recommends that endoscopists achieve an overall ADR of 25% or higher.[6]

Another metric known as adenomas per colonoscopy (APC) may be superior to ADR with respect to stratifying high detecting endoscopists from low detectors[7–14] since it credits endoscopists for *each* adenoma detected. Thus, APC may be a better measure of the endoscopist's ability to clear the colon of adenomas, which is essential to maximize CRC prevention. While it has been shown that ADR and APC are closely correlated, [15, 16] in one comparison study, the number of adenomas detected (APC) varied among endoscopists with similar ADRs.[17] Thus, APC may be a better quality measure for endoscopists.

A major limitation to the implementation of APC as an endoscopy quality measure is that there are little data examining its association with risk for post colonoscopy CRC (PCCRC), as has been shown for ADR. These data would be crucial for validating APC as a colonoscopy quality measure. The New Hampshire Colonoscopy Registry (NHCR) is a statewide population-based database which collects longitudinal data from index and subsequent colonoscopies for patients in NH. We used NHCR data to examine the association between risk for PCCRC and endoscopist APC.

Methods

Population

NHCR data collection methods have been previously published and are briefly described here.[18, 19] Individuals who have a colonoscopy in NH are invited to participate in the NHCR, which involves the collection of data from index colonoscopy as well as subsequent exams. Patients complete an NHCR Patient Questionnaire prior to colonoscopy, which includes demographic, health behavior, and personal and family history data. The NHCR Colonoscopy Procedure Form is completed by endoscopists and/or endoscopy nurses during or immediately after colonoscopy.

Bowel preparation quality is assessed for every colonoscopy, “based on the segment (after cleaning all colon segments) which has the worst quality of preparation” following detailed descriptions of each preparation quality option noted on the NHCR Procedure form. Trained NHCR abstractors match polyp-level pathology data to each finding recorded on the NHCR Procedure Form.[20] To ensure complete data on colorectal cancers diagnosed in NHCR patients, the NHCR utilizes linkages with the NH State Cancer Registry and other relevant state cancer registries (Vermont, Maine, Massachusetts, and Florida). All data collection and study procedures were approved by the Committee for the Protection of Human Subjects at Dartmouth College (CPHS#00015834).

Analyzed Sample

Our primary analysis included data from all index colonoscopies performed on patients in the NHCR database who had a follow-up event in the form of at least one surveillance colonoscopy performed 6 months or longer after the index exam, or a diagnosis of CRC at colonoscopy or as recorded in the NH State Cancer Registry. Index exams were required to be performed for non IBD and non-familial genetic cancer syndrome indications with complete endoscopist information. Exams with CRC diagnosed at index or within 6 months of index exam were excluded.

In a sensitivity analysis we also examined data from all index colonoscopies including those with no follow up event, either a colonoscopy or a CRC diagnosis. In this sample, the time frame for censoring was 6 months before the time of last linkage of the NHCR to the NH State Cancer Registry to allow for CRC diagnosis and reporting of the CRC to the NH State Cancer Registry.

Outcomes

Our main outcome was post colonoscopy colorectal cancer (PCCRC), which is CRC diagnosed 6 months or longer after index exam. As conducted in a previously published analysis[21], we examined PCCRC within 3 follow up time periods: a) 6–36 months, b) 6–60 months, as well as c) the entire follow-up time period which was any CRC diagnosed 6 or more months after the index exam. In addition, to account for patients with multiple follow-up surveillance exams, we performed another analysis where we restricted outcomes to those found on the first follow-up event, whether captured within colonoscopy data in the NHCR or CRC diagnosis obtained through linkage with the NH State Cancer Registry.

Exposure variable

Our exposure of interest was endoscopist-specific APC detection rates. This was calculated at the endoscopist level by dividing the number of adenomas detected in their complete screening exams with adequate bowel preparation by their total number of complete screening exams with adequate bowel preparation. We examined the association between PCCRC and quintiles of endoscopist level APC detection rates while being cognizant of published data and expert recommendation.[14, 22] We also calculated ADR for each endoscopist by dividing the number of complete screening colonoscopies with adequate preparation and at least one adenoma by the total number of similar screening exams. Finally, we examined our exposure variable by stratifying endoscopists by an ADR of 25 and median APC as done in other studies examining serrated polyps.[23–25]

Covariates

Covariates in our models included age, sex, year of index exam (pre-2012 vs 2012 on), index findings of serrated polyps[19] (traditional serrated adenomas (TSAs) or sessile serrated polyps (SSPs)) or conventional advanced adenomas (large (≥ 1 cm), with villous elements or high grade dysplasia), index exam indication (screening (reference), surveillance and diagnostic)), bowel preparation quality (poor preparation; yes versus no), endoscopy center (academic versus non-academic), history of previous significant neoplasia including CRC and whether there was >1 surveillance exam.

Statistical analysis

Means and standard deviations were calculated for continuous variables while numbers and percents were derived for proportions. We used the chi squared test for trend and Fisher's exact test to evaluate categorical variables. T-tests were used to compare continuous variables and Mann-Whitney U tests were used for continuous variables with non-Gaussian distributions. Cox regression was used to model the hazard of PCCRC on the detection rates controlling for age, sex, year of index exam, indication of index exam, presence of advanced adenomas or SSPs or TSAs on index exam, bowel preparation quality, and having more than 1 surveillance exam (SPSS 27, IBM). For each patient in the primary analysis, we calculated follow-up time from the date of their index exam until the time of second colonoscopy or CRC diagnosis, which was at least 6 months from index.

Results

Sample

Our analyzed sample included 32,535 patients in the New Hampshire Colonoscopy Registry with a follow-up event 6 months or longer after index colonoscopy, both of which were performed between October 2004 and October 2022. There were 178 CRCs diagnosed at least 6 months after an index exam. As compared to patients with no CRC diagnosed post colonoscopy, those with PCCRC were significantly more likely to be older andhave a shorter time to the follow-up event. Other characteristices of the index exam which were associated with PCCRC included an exam date before 2012, a non-screening indication, findings of

advanced neoplasia and an endoscopist with a lower APC or at a non-academic endoscopy center. These data are shown in Table 1.

APC detection rates

Index colonoscopies were performed by 152 endoscopists. The median number of exams per endoscopist was 555 (IQR:176–1349). The median APC for endoscopists was 0.47 (IQR= 0.35). Using the endoscopist APC detection rate data we divided the exams into quintiles of endoscopist APCs; 0.25, 0.40, 0.50 and 0.70. Thus, the groups included exams completed by endoscopists with APCs of 0 - < 0.25 (n=27 endoscopists), 0.25 - < 0.40 (n=29), 0.40 - < 0.50 (n=30), 0.50 - < 0.70 (n=33) or 0.70 and greater (n=33). Gastroenterologists had higher APC detection rates than non-gastroenterologists.

Patients whose exams were performed by endoscopists with higher APCs had lower unadjusted risks for PCCRC than patients whose exams were performed by endoscopist with APC < 0.25. These data are shown in Table 2. After adjusting for covariates, Cox regression analyses demonstrated that the hazard for PCCRC had a monotonic (eg linear) decrease as APC increases and the hazard ratio for trend is statistically significant. These data are shown in Table 2. We observed that an increased HR for PCCRC was associated with patient age (per year) (HR=1.12 95% CI: 1.10–1.14), advanced adenoma on index (HR=2.89 95% CI: 1.84–4.54), higher risk surveillance (past history of CRC) (HR=3.15 95% CI: 1.28–7.77), indication for exam (screening reference; surveillance (HR=1.42 95% CI: 0.99–2.05) and diagnostic (HR=2.50 95% CI: 1.73–3.63) and having colonoscopy at an academic center (HR=0.48 95% CI: 0.32–0.72) were all associated with an increased HR for PCCRC. Although, index exams before 2012 was associated with a higher risk for PCCRC on bivariate analysis, it was not statistically significant in the Cox Regression Model (HR=0.88 95% CI: 0.63–3=1.22). We also examined the unadjusted risks as well as the HRs across the 2 additional follow-up time periods (6–36 months, and 6–60 months) and observed no significant differences (Table 2).

We further examined APC by stratifying exams by an ADR of 25 and median APC (0.47 rounded to 0.50). As compared to those exams with an ADR < 25 and those with an ADR ≥ 25 and an APC < 0.50, those with an ADR ≥ 25 and an APC ≥ 0.50 had lower HRs for PCCRC (Table 3). A large proportion of endoscopists, over 1/5th (32/152; 21.1%), had an ADR ≥ 25 but an APC < 0.50. The split of gastroenterologists vs non GIs between APC>=.5 and APC<.5 (among the ADR>25%) is similar, approximately ¾ are gastroenterologists. Furthermore, 61% of ADR<25% are non- gastroenterologists.

We also examined the impact of ADR by adding ADR as a continuous variable into the Cox Regression and observed no significant changes in the HRs observed in the primary analysis: < 0.25 (Reference; HR=1.0) (0.25-<0.40: HR=0.22, 95% CI: 0.11–0.42; 0.40-<0.50: HR=0.18, 95% CI: 0.07–0.46; 0.50-<0.70: HR=0.10, 95% CI: 0.03–0.34; and ≥0.70: HR=0.08, 95% CI: 0.01–0.41).

To examine the potential impact of CRCs diagnosed on a 2nd surveillance colonoscopy, we examined the association between APC and PCCRC only for CRCs diagnosed on a patient's first on the first follow-up event, whether captured within colonoscopy data in the NHCR or

CRC diagnosis obtained through linkage with the NH State Cancer Registry, excluding those CRCs diagnosed on any subsequent colonoscopy. The results were largely unchanged. These data are shown in Table 4.

Sensitivity analyses

Finally, we examined data from all index exams including those patients with no follow up. We censored these patients 6 months prior to linkage between the NHCR and the NH State Registry to account for adequate time for reporting of the potential cancers to the NH State Registry as opposed to the primary analysis in which the patients were censored at the follow up event (colonoscopy or CRC diagnosis in NH State Registry). There were an additional 81,728 patients (45.5% male, 96.0% white, average age 58.3 (± S.D. 11.4)) without a follow up event who had an average time to censoring of 60.2 months (S.D. ± 34.0). The median APC for exams in these patients was 0.47 (IQR: 0.24). The results of the Cox Regression showed that higher APCs were associated with lower HRs but the point estimates were more modest that the primary analysis (Table 5).

Discussion

Ensuring optimal CRC prevention through colonoscopy is dependent on careful inspection of the mucosa to ensure complete detection and resection of all adenomas.[26] Published data suggest that missed lesions are likely responsible for many post colonoscopy CRCs.[8, 27, 28] Thus, an endoscopist's adenoma miss rate should be minimal in order to ensure maximum protection from CRC. Since measurement of actual miss rates requires tandem colonoscopy, which is impractical in the clinical setting, ADR has been proposed as a surrogate quality measure.[1, 2, 14] Currently an ADR of 25% is the accepted nationally recommended benchmark[6], supported by studies which have shown that higher ADRs are protective against the incidence of post-colonoscopy colorectal cancer (PCCRC) diagnosed after a colonoscopy in which no cancer was found.[29–31] While the initial study by Kaminski et al demonstrated a decreased incidence of PCCRC for an ADR of 20% or greater, subsequent studies have shown that higher ADRs may offer still more protection.[3, 4, 32] Furthermore, published data suggest that patients with high risk findings whose exams were performed by endoscopists with higher ADR have a lower risk of PCCRC. [33] Thus, higher endoscopist ADR is crucial in reducing the risk for PCCRC.

However, given that another proposed metric, adenomas per colonoscopy (APC), credits those endoscopists for the number of adenomas detected, APC may be a better measure of an endoscopist's ability to detect adenomas and thus clear the colon of these lesions. A previous study has demonstrated that among endoscopists with similar ADRs, there can be significant variation in APC in individuals with adenomas.[17] Thus, detection rates which credit endoscopists who detect more adenomas may be superior to ADR in distinguishing endoscopists with respect to their ability to prevent CRC.

However, there are scant published data validating APC as quality measure; specifically, one study which examined the association between endoscopist APC and PCCRC.[22] This recent investigation analyzed data from a Polish colonoscopy study, demonstrating that an APC of 0.37 or higher had a comparable association with PCCRC as an ADR of 25%. This study

was limited by low detection rates overall (median ADR=17.9%), potentially impacting its generalizability to other studies with higher median ADRs.

Our novel findings suggest that a patient who had an exam by an endoscopist with a higher APC may have a lower risk of PCCRC than a patient whose endoscopist had a lower APC. While the point estimates for the hazards of PCCRC in patients whose endoscopists had APCs in the two highest quintiles were lower than those for patients of endoscopists with APCs in the lower 3 quintiles (APC < 0.50), suggesting higher APC may offer more protection, their confidence intervals overlapped. The cutoff of 0.50 is consistent with a recent expert recommendation for an APC benchmark for screening exams[14].

When examining exams performed by endoscopists with an ADR of at least 25%, an APC < 0.50 was associated with significantly higher PCCRC hazard than an APC ≥ 0.50 (HR=1.65; 95% CI: 1.06–2.56).Of note, a large proportion of endoscopists, over 1/5th (32/152; 21.1%), had an ADR ≥ 25 but an APC < 0.50. While some of the endoscopists with and ADR ≥ 25 and an APC < 0.5 could be considered to approximate “one and done” performers, a recent analysis of the NHCR demonstrated that this phenomena had a low frequency in the NHCR.[12] In addition, after adding ADR as a continuous variable into the Cox Regression model, higher APCs were still inversely associated with lower hazards for PCCRC. Therefore, APC also was an independent predictor of PCCRC. Thus, our data suggest that even in endoscopists who achieve an ADR of 25 or greater, ensuring an APC of 0.5 might be warranted. If an endoscopist’s detection rate falls below this benchmark, attention should be given to withdrawal time and inspection technique. Using a withdrawal rate of at least 8 minutes as well as examining the right colon twice have been shown to increase adenoma detection.[34, 35]

We observed that gastroenterologists had higher detection rates than non-gastroenterologists. The lowest quintile of APC (< 0.25) was comprised of a high percentage of non gastroenterologists (70.4%). In addition, colonoscopies performed at academic centers were less likely to have PCCRC than those at non academic centers. Other factors such as serrated detection ability may be important. We have published data demonstrating that higher serrated detection rates were associated with lower risks for PCCRC.[23, 36] Not surprisingly, exams with PCCRC were less likely to have been performed by an endoscopist with an SSP rate 6% or higher.

The NHCR database was able to provide novel data for many reasons. The comprehensive colonoscopy data of the NHCR as well as its precise pathology matching protocol allowed us to derive accurate counts of the number of adenomas detected per colonoscopy.[20] Specifically, we have trained abstractors in the NHCR who match polyp-level pathology data to each endoscopic finding which is recorded on the NHCR Procedure Form after the colonoscopy. Other strengths include the large number of endoscopists who participate in the NHCR, as well as its longitudinal data collection, which allows for analyses which follow specific patients over many years. Detailed colonoscopy indication information allows us to examine detection rates that were calculated for screening exams only, which is the accepted approach for deriving these rates.[37]

In addition, the NHCR database captures standardized data on bowel preparation quality[18, 38], allowing for uniform assessment. A long-standing linkage with the NH State Cancer Registry strengthens outcome data by identifying those patients who may have been diagnosed with CRC outside of NHCR-captured colonoscopies. Finally, our database captures detailed information on patients and exams which are important in examining risk for CRC, for example, patient history and exam indication which have been shown to be predictive of ADR in previous published data including data from the NHCR.[37, 39] In addition, using data for exam indication, we were able to exclude all patients with IBD, which can be a significant risk for PCCRC.[15] Thus, our data may be more generalizable to those patients at risk for sporadic CRC as opposed to those who are at increased risk due to IBD.

Although our results are robust even after adjusting for important covariates, we acknowledge that there may be other potential confounders. Our data are also from a single state which may limit generalizability to other populations. However, although New Hampshire lacks significant racial diversity, our population includes substantial ethnic, socioeconomic and rural/urban diversity.[40] It will be helpful to assess these results in other more racially diverse settings. Implementation into practice is an important issue when creating quality indicators. A potential limitation for the application of APC in practice is that it may increase the burden on endoscopists with respect to counting all adenomas that are removed in each patient. If APC were to be used prospectively it might incentivize physicians to place individual polyps in separate bottles, which could have cost ramifications. To some extent photography of all lesions (with artificial intelligence assistance) could support calculation of APC as well as documentation of the actual number of adenomas for billing purposes, and compliance with follow-up guideline recommendations based on multiplicity.[9, 41]

In summary, we observed that index colonoscopies performed by endoscopists with higher APCs were associated with a decreased hazard for PCCRC. Therefore, our results validate APC as an important quality measure for endoscopists, one that appropriately credits endoscopists with the number of adenomas detected and removed during colonoscopy. Furthermore, among endoscopists who had an ADR of 25 or greater, those with an APC of < 0.50 had a higher risk for PCCRC than those with an APC ≥ 0.50. Our data suggest quality improvement programs may identify important deficiencies in endoscopist detection performance by measuring APC for endoscopists with ADR $\geq 25\%$.

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views of the Centers for Disease Control and Prevention or New Hampshire Department of Health and Human Services.

Abbreviations and Acronyms

APC	Adenoma per colonoscopy
NHCR	New Hampshire Colonoscopy Registry
ACG	American College of Gastroenterology
ASGE	American Society for Gastrointestinal Endoscopy
AGA	American Gastroenterological Association
CRC	Colorectal Cancer
IBD	Inflammatory bowel disease
USMSTF	US Multi Society Task Force
ADR	Adenoma detection rate
CRC	Colorectal Cancer
PCCRC	Post colonoscopy Colorectal Cancer
SPSS	Statistical Package for the Social Sciences

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Table 1.

Characteristics of the patients and colonoscopies with and without PCCRC.

	Index exams with follow up event		
Characteristic	**Follow up with no PCCRC**	**Patients with PCCRC**	**P value (PCCRC versus no PCCRC)**
Patients	N=32,357	N=178	
Sex (% male)	*47.9% (15,483)	44.4% (79)	0.36
Age (average, ±S.D.)	57.9 (9.5)	65.1 (10.7)	<0.01
Race (Caucasian % (n))	96.5% (29,185) **	95.9% (162) ***	0.9
BMI (average, ±S.D.)	28.5 (6.2)	28.4 (6.3)	0.60
Smoking > 20 pack yrs	25.8% (7421)#	29.1% (46)##	0.38
FDR CRC (%)	22.8% (7383)	19.7% (35)	0.70
Exam			
Year (% Before 2012)	58.9% (19,064)	42.1% (75)	<0.001
Academic Center (Yes versus no)	27.7% (8958)	19.1% (34)	0.013
Exam Indication			
Screening	55.4% (17929)	38.2% (68)	0.001
Surveillance	27.2% (8798)	33.7% (60)	
Diagnostic	17.4% (5630)	28.1% (50)	
High Risk	0.8% (256)	2.8% (5)	0.02
Cecal intubation	98.6% (31,918)	97.2% (173)	0.09
CSSP on index	10.6% (3417)	8.4% (15)	0.36
SSP/TSA on index	7.2% (2314)	4.5% (8)	0.20
Adv neoplasia on index	8.6% (2772)	12.9% (23)	0.04
Bowel Prep (% poor)	2.1% (665)	2.2% (4)	0.86
Follow up to 1st exam or diagnosis (average months, +S.D.) (Median; IQR)	66.5 (33.2) 63.0 (36.5)	56.5 (34.5) 53.5(42.8)	<0.001 <0.001
APC detection rate (average, +S.D.)	0.50 (0.20)	0.40 (0.16)	<0.001
APC (median; (IQR)	0.47 (0.25)	0.39 (0.20)	<0.001
SSPDR 6%	27.9% (9039)	10.7% (19)	<0.001
ADR (median; (IQR)	28.6 (10.7)	25.6 (9.2)	<0.001

* missing=45 (0.1%)

** missing = 2123 (6.6%)

*** missing = 9 (5.1%)

missing = 3,544

missing = 20

Table 2

Unadjusted Risks and adjusted Hazard Ratios for PCCRC and APC for all time periods

		< 0.25 (REF)	**0.25 - < 0.40**	**0.40 - < 0.50**	**0.50 - < 0.70**	**≥ 0.70**	**P value**	**Total**
GI endoscopists		29.6% (8)	58.6% (17)	66.7% (20)	78.8% (26)	75.8% (25)	0.001	
Non GI		70.4% (19)	41.4% (12)	33.3% (10)	21.2% (7)	24.2% (8)		
All Exams								
Entire follow-up period	HR 95%CI	1.0 REF	0.35 (0.22–0.56)	0.31 (0.20–0.49)	0.20 (0.11–0.36)	0.19 (0.09–0.37)	<0.0001	---
	Risk	2.08%	0.69%	0.58%	0.28%	0.20%	<0.001	0.55%
	N	(n=30)	(n=61)	(n=56)	(n=19)	(n=12)		(n=178)
	Total	1443	8849	9692	6693	5858		32,535
Results Stratified by Time Periods								
6–36 months	HR 95%CI	1.0 REF	0.32 (0.14–0.70)	0.19 (0.08–0.43)	0.14 (0.05–0.37)	0.09 (0.03–0.28)	<0.001	---
	Risk	0.76%	0.21%	0.13%	0.10%	0.07%	<0.001	0.17%
	N	(n=11)	(n=19)	(n=13)	(n=7)	(n=4)		(n=54)
	Total	1443	8849	9692	6693	5858		32,535
6–60 months	HR 95%CI	1.0 REF	0.24 (0.13–0.43)	0.23 (0.13–0.40)	0.16 (0.08–0.32)	0.14 (0.06–0.31)	<0.001	---
	Risk	1.46%	0.32%	0.31%	0.19%	0.15%	<0.001	0.31%
	N	(n=21)	(n=28)	(n=30)	(n=13)	(n=9)		(n=101)
	Total	1443	8849	9692	6693	5858		32,535

Cox regression was used to model the hazard of PCCRC on the detection rates controlling for age, sex, year of index exam, indication of index exam, presence of advanced adenomas or sessile serrated polyps/Traditionally Serrated Adenomas on index exam, bowel preparation quality, Academic center and having more than 1 surveillance exam (SPSS 27, IBM).

Table 3.

Unadjusted Risk and Hazard Ratios for PCCRC and APC 0.50 as stratified by ADR of 25

	Adequate ADR and APC	**Adequate ADR and inadequate APC**	**Inadequate ADR and APC**	
	ADR ≥ 25 and APC ≥ 0.50 (REF)	ADR ≥ 25 and APC < 0.50	ADR < 25 and APC < 0.50	P value
Number of Physicians	N=66 (43.4%)	N=32 (21.1%)	N=54 (35.5%)	---
Gastroenterologists %(N)	N=51 (77.3%)	24 (75.0%)	21 (38.9%)	0.0001
Hazard Ratio	1.0	1.65	2.58	<0.001
95 % CI	REF	1.06–2.56	1.67–3.99	
Unadjusted Risk	0.25% (n=31)	0.64% (n=71)	0.86% (n=76)	< 0.001
N	12,551	11,172	8812	32,535

Cox regression was used to model the hazard of PCCRC on the detection rates controlling for age, sex, year of index exam, indication of index exam, presence of advanced adenomas or sessile serrated polyps/Traditionally Serrated Adenomas on index exam, bowel preparation quality, Academic center and having more than 1 surveillance exam (SPSS 27, IBM).

Table 4.

Unadjusted Risk and Hazard Ratios for PCCRC and APC in patients with one follow up event (N=32,535)

	< 0.25 (REF)	**0.25 - < 0.40**	**0.40 - < 0.50**	**0.50 - < 0.70**	**≥ 0.70**	**P value**	**Total**
Hazard Ratio 95 % CI	1.0 REF	0.39 0.24–0.66	0.38 0.23–0.62	0.22 0.11–0.41	0.19 0.09–0.41	<0.001	N/A
Risk	1.66%	0.55%	0.52%	0.22%	0.15%	<0.0001	0.45%
N	(n=24)	(n=49)	(n=50)	(n=15)	(n=9)		(N=147)
Total	1443	8849	9692	6693	5858		32,535

Cox regression was used to model the hazard of PCCRC on the detection rates controlling for age, sex, year of index exam, indication of index exam, presence of advanced adenomas or sessile serrated polyps/Traditionally Serrated Adenomas on index exam, bowel preparation quality, Academic center and having more than 1 surveillance exam (SPSS 27, IBM).

Table 5.

Unadjusted Risk and Hazard Ratios for PCCRC and APC in all patients with index exams who had a follow up event (n=32,535) as well as those without a follow up event (n=81,728) (Total n= 114,263)

	< 0.25 (REF)	**0.25 - < 0.40**	**0.40 - < 0.50**	**0.50 - < 0.70**	**≥ 0.70**	**P value**
Hazard Ratio 95 % CI	1.0 REF	0.67 0.42–1.06	0.61 0.39–0.97	0.36 0.20–0.65	0.36 0.19–0.74	0.004
Risk	0.25%	0.23%	0.18%	0.08%	0.06%	0.16%
N	(n=30)	(n=61)	(n=56)	(n=19)	(n=12)	(178)
Total	12,099	27,087	31,393	24,242	19,442	114,263

Cox regression was used to model the hazard of PCCRC on the detection rates controlling for age, sex, year of index exam, indication of index exam, presence of advanced adenomas or sessile serrated polyps/TSAs on index exam, bowel preparation quality, Academic center and having more than 1 surveillance exam (SPSS 27, IBM).