ENDOSCOPY

Variation in Colonoscopy Performance Measures According to Procedure Indication

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This article has an accompanying continuing medical education activity, also eligible for MOC credit, on page e65. Learning Objective–Upon completion of this activity, successful learners will be able to name the indication for colonoscopy associated with the lowest rate of adequate colon cleansing; list the indications for colonoscopy associated with the highest adenoma detection rates; name the indication for endoscopic evaluation that has the highest advanced adenoma detection rate; list the indication for colonoscopy associated with the highest colorectal cancer detection rate.

BACKGROUND & AIMS: **Most fulfillment and benchmarking information for colonoscopy quality indicators has been obtained from studies of primary screening colonoscopies. We analyzed differences in the fulfillment of colonoscopy quality indicators based on the indication for endoscopy.**

METHODS: **We performed an observational, multicenter, cross-sectional study of 14,867 patients who underwent endoscopy procedures for gastrointestinal symptoms (40.3%), a positive result from a fecal immunochemical test (36.0%), postpolypectomy surveillance (15.3%), or primary screening (8.4%), from February 2016 through December 2017 at 14 centers in Spain. We evaluated rates of adequate colon cleansing, cecal intubation, adenoma detection, and colorectal cancer detection, among others. We used findings from primary screening colonoscopies as the reference standard.**

RESULTS: **Fewer than 90% of patients had adequate bowel preparation; 83.1% of patients with gastrointestinal symptoms had adequate bowel preparation (odds ratio [OR] compared with patients with primary screening colonoscopies, 0.62; 95% CI, 0.49–0.78) and 85.3% of patients receiving postpolypectomy surveillance had adequate bowel preparation (OR, 0.71; 95% CI, 0.55–0.91). The cecal intubation rate was also lower in patients with gastrointestinal symptoms (93.1%) (OR, 0.34; 95% CI, 0.22–0.52). The adenoma detection rate was higher in patients with a**

Abbreviations used in this paper: **+FIT, positive fecal immunochemical test; ADR, adenoma detection rate; ASGE, American Society for Gastrointestinal Endoscopy; CIR, cecal intubation rate; CRC, colorectal cancer; ESGE, European Society of Gastrointestinal Endoscopy; OR, odds ratio; SDR, serrated polyp detection rate.**

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positive result from a fecal immunochemical test (46.4%) (OR, 2.01; 95% CI, 1.71–2.35) and in patients undergoing postpolypectomy surveillance (48.2%) (OR, 1.41; 95% CI, 1.20–1.67). The highest proportion of patients with colorectal cancer was in the gastrointestinal symptom group (5.1%) (OR, 5.24; 95% CI, 2.30–11.93) and the lowest was in patients undergoing surveillance (0.8%) (OR, 0.83; 95% CI, 0.32–2.14).

CONCLUSIONS: **Fulfillment of colonoscopy performance measures varies substantially by indication. Policies addressing performance measures beyond colonoscopy screening procedures should be developed. Benchmarking recommendations could be adjusted according to colonoscopy indication.**

Keywords: Comparison; Colon Cancer; ADR; FIT.

Colonoscopy is the key procedure in the prevention and diagnosis of colorectal cancer (CRC). Quality of colonoscopy has become an increasingly important topic because of its relationship with the effectiveness of this technique in CRC prevention. Specifically, a low adenoma detection rate (ADR) has been related directly to the development of interval cancer.[1,2] Thus, high-quality procedures are needed to optimize the role of colonoscopy in CRC prevention.[3–5] Since CRC screening programs have been implemented, many improvements are evident from the perspective of patients and endoscopists, and different performance measures have been developed for screening colonoscopy. However, the quality of a colonoscopy is highly variable, with important differences in fulfillment of quality indicators among procedures, endoscopists, and endoscopy units.[6–8] In 2015, the American Society for Gastrointestinal Endoscopy (ASGE) presented an updated document about colonoscopy performance measures,[9] and, in 2017, the European Society of Gastrointestinal Endoscopy (ESGE) published a guideline that established which quality indicators showed a proven impact on significant clinical outcomes, a simple method for measurement, and the possibility of application to all levels of endoscopy services.[10]

The majority of fulfillment and benchmarking information for colonoscopy quality indicators has been obtained from primary screening colonoscopies.[5,9,10] However, data are scarce regarding other colonoscopy indications (eg, gastrointestinal symptoms or postpolypectomy surveillance) and it is not well known whether quality indicators behave the same way regarding procedure indication. Therefore, minimum standard recommendations of quality indicators may change according to procedure request. This study aimed to analyze differences in the fulfillment of colonoscopy quality indicators based on procedure indication.

Methods

Study Characteristics and Population

This was an observational, prospective, multicenter, cross-sectional study. Inclusion criteria were patients aged 40 to 80 years old, and 4 endoscopic procedure indications: gastrointestinal symptoms; positive fecal immunochemical test (+FIT) (OC-Sensor (Eiken Chemical Co, Ltd, Japan); cut-off level, 20 μg/g); postpolypectomy surveillance; and primary screening colonoscopy. Exclusion criteria were as follows: having been diagnosed with CRC or adenomas within the previous 6 months, colonoscopies to review incomplete excision or piecemeal resection, emergency colonoscopies, endoscopic procedures to treat colon strictures or because of an abdominal or rectal mass suspicion, and having been diagnosed with inflammatory bowel disease or hereditary cancer syndrome. Procedures performed by residents also were excluded.

Patients were enrolled prospectively between February 2016 and December 2017 across 14 participating centers in Spain. Patients who underwent a colonoscopy at these centers during this period were recruited using consecutive sampling.

This study was approved by the ethical review board of each participating center, and written informed consent was obtained from each patient included in the study. Ethical board approval of this study was granted on May 27, 2015. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a prior approval by the institution's human research committee.

Variables

Information about patients' demographic data or about procedure was collected when patients were at Endoscopy Units and registered anonymously in the Research Electronic Data Capture database. Colonoscopy indication was determined by the physician who requested the procedure. From all polyps found, location, size, morphology, and polypectomy technique were recorded.

The colonoscopy quality indicators listed were defined according to the ESGE Guideline[10]:

- The Boston Bowel Preparation Scale was used to describe colon cleansing. An adequate colon cleansing rate was defined as the percentage of colonoscopies that obtained 2 or 3 points in each colon segment.
- The cecal intubation rate (CIR) was considered the percentage of colonoscopies reaching and visualizing

the whole cecum and its landmarks. An unadjusted CIR was reported in this study.

- The ADR and polyp detection rate were described as the percentage of colonoscopies in which at least 1 conventional adenoma or 1 polyp was detected in all patients included, respectively.
- The withdrawal time was calculated as the mean time spent to withdraw the endoscope from the cecum to anal canal and inspect the entire bowel mucosa at normal procedures (no biopsy or therapy). Each participating center calculated this parameter according to local protocols.
- An appropriate polypectomy technique evaluated the rate of polyps larger than 3 mm in size removed at colonoscopy with snare polypectomy (cold or with diathermy).
- The polyp retrieval rate considered polypectomies of polyps larger than 5 mm in size that were retrieved for histopathology examination.

Other detection rates also were calculated. The CRC detection rate, advanced ADR, or serrated polyp detection rate (SDR) assessed the percentage of colonoscopies in which 1 or more CRCs, advanced adenoma, or serrated polyp, respectively, were found. An advanced adenoma was considered when an adenoma was 10 mm or larger, had tubulovillous or villous architecture, or had high-grade dysplasia. Serrated polyps were considered as sessile serrated polyps, traditional serrated adenomas of any size or location, and hyperplastic polyps that were 5 mm or larger or proximal to the rectosigmoid. Isolated rectosigmoid hyperplastic polyps that were 5 mm or smaller were not considered serrated polyps. The adenoma per colonoscopy or serrated polyp per colonoscopy rates were the mean number of adenomas or serrated polyps identified per colonoscopy, respectively. The proximal location of lesions was considered if they were located in the cecum, ascending colon, or transverse colon, and were considered distal lesions if they were located in the descending colon, sigmoid colon, or rectum.

Statistical Analysis

Continuous variables were reported as means (SD) and categoric variables were reported as a frequency or percentage. Minimum and maximum observations were represented by range. Trendlines for the ADR in each indication were calculated based on endoscopists who performed procedures in all indications and had a total volume of 20 or more colonoscopies in our study. The chi-square test was used for categoric data and the Student *t* test and analysis of variance were used as parametric tests for quantitative data. Multiple comparisons were evaluated using the Bonferroni correction test. Logistic regression analysis was used to analyze the influence of procedure indication on colonoscopy quality indicators adjusted by sex, age, body mass index, comorbidities, and aspirin use. Population proportions and 95% CIs were calculated using the exact Clopper–Pearson method. Primary screening colonoscopy was considered the reference category. Reported *P* values were 2-sided, and a *P* value less than .05 was applied to indicate statistical significance. All calculations were performed using SPSS version 21.0 software (IBM Corp, Armonk, NY).

What You Need to Know

Background

Most fulfillment and benchmarking information for colonoscopy quality indicators has been obtained from primary screening colonoscopies. We investigated how these indicators differ in patients undergoing colonoscopy for different indications.

Findings

We found substantial variation in fulfillment of quality indicators. The adenoma detection rate and other performance measures were higher in individuals with a positive result from a fecal immunochemical test compared with other indications.

Implications for patient care

Policies addressing performance measures beyond colonoscopy screening procedures should be developed to improve colonoscopy quality. Benchmarking for procedures must be adjusted according to indication.

Results

Characteristics of Eligible Patients and Procedures

A total of 14,867 procedures in the same number of patients from 14 centers were included between February 2016 and December 2017; all centers were Spanish tertiary hospitals. Table 1 shows the baseline characteristics of patients and procedures. A total of 7704 procedures (51.8%) were performed in men, and the mean age was 61.2 years (SD, ±9.4 y). The majority of procedures were performed because of gastrointestinal symptoms (40.3%), followed by +FIT (36.0%), postpolypectomy surveillance (15.3%), and primary screening colonoscopies (8.4%). The main bowel cleansing products used were polyethylene glycol 2 L plus ascorbate (36.8%), and sodium picosulfate with magnesium citrate (36.1%). In all, 94.0% of the procedures were performed under sedation; in 72.6% of these procedures, propofol sedation was used. In the majority of the procedures, sedation was under the direction of the endoscopist (77.7%). Almost three quarters (74.1%) of the procedures were performed using high-definition equipment. All endoscopists were gastroenterology specialists and 53.8% (98) of endoscopists performed 50 or more procedures in our study.

Table 1. Baseline Characteristics of Patients and Procedures Based on Indication

Characteristics of patients and procedures	Total	Endoscopic procedure indication				
		Gastrointestinal symptoms	+FIT	Postpolypectomy surveillance	Primary screening colonoscopy	*P* value[a]
Procedures, n (%)	14,867 (100.0)	5988 (40.3)	5351 (36.0)	2279 (15.3)	1249 (8.4)	–
Sex, n (%)						
Male	7704 (51.8)	2746 (45.9)	3005 (56.2)	1407 (61.7)	546 (43.7)	<.001
Female	7163 (48.2)	3242 (54.1)	2346 (43.8)	872 (38.3)	703 (56.3)	
Age, *y*						
Means ± SD	61.2 ± 9.4	61.1 ± 11.0	61.5 ± 7.1	63.8 ± 8.4	55.8 ± 9.4	<.001
Range	40–80	40–80	40–80	40–80	40–80	
Age group, n (%)						
40–49 *y*	1673 (11.2)	1072 (17.9)	142 (2.6)	120 (5.3)	339 (27.1)	<.001
50–59 *y*	4281 (28.8)	1468 (24.5)	1847 (34.5)	498 (21.9)	468 (37.5)	
60–69 *y*	5776 (38.9)	1770 (29.6)	2674 (50.0)	1014 (44.5)	318 (25.5)	
70–80 *y*	3137 (21.1)	1678 (28.0)	688 (12.9)	647 (28.3)	124 (9.9)	
Body mass index, kg/m^2						
Means ± SD	27.4 ± 4.8	27.1 ± 5.0	28.0 ± 4.8	27.4 ± 4.5	26.7 ± 4.5	<.05
Range	14–59	14–59	15–58	15–52	16–46	
Comorbidities, n (%)						
Diabetes	1677 (11.3)	750 (12.5)	518 (9.7)	320 (14.0)	89 (7.1)	<.001
Ischemic heart disease	712 (4.8)	320 (5.3)	203 (3.8)	157 (6.9)	32 (2.6)	
Chronic kidney disease	240 (1.6)	115 (1.9)	64 (1.2)	48 (2.1)	13 (1.0)	
Other	4094 (27.5)	1780 (29.7)	1134 (21.2)	879 (38.6)	301 (24.1)	
Medications, n (%)						
Acetylsalicylic acid	1431 (9.6)	626 (10.4)	460 (8.6)	281 (12.3)	64 (5.1)	<.05
Clopidogrel	226 (1.5)	102 (1.7)	67 (1.2)	52 (2.3)	5 (0.4)	
NSAIDs	308 (2.1)	120 (2.0)	130 (2.4)	46 (2.0)	12 (1.0)	
Acenocoumarol	404 (2.7)	184 (3.1)	117 (2.2)	83 (3.6)	20 (1.6)	
Warfarin	20 (0.1)	10 (0.2)	7 (0.1)	3 (0.1)	0 (0.0)	
NOAC	116 (0.8)	50 (0.8)	33 (0.6)	29 (1.3)	4 (0.3)	
Colon cleansing product used, n (%)						
PEG 4 L	3735 (25.1)	1860 (31.0)	764 (14.3)	772 (33.9)	339 (27.1)	<.001
PEG 2 L + ascorbate	5468 (36.8)	2622 (43.8)	1594 (29.8)	735 (32.2)	517 (41.4)	
SPMC	5362 (36.1)	1364 (22.8)	2883 (53.9)	743 (32.6)	372 (29.8)	
Other products	302 (2.0)	142 (2.4)	110 (2.0)	29 (1.3)	21 (1.7)	
Sedation rate, n (%)	13,975 (94.0)	5719 (95.5)	4902 (91.6)	2154 (94.5)	1200 (96.1)	<.001
Sedation regimen, n (%)						
Propofol sedation	10,148 (72.6)	3795 (66.4)	3579 (73.0)	1793 (83.2)	981 (81.8)	<.001
Conscious sedation	3827 (27.4)	1924 (33.6)	1323 (27.0)	361 (16.8)	219 (18.2)	

+FIT, positive fecal immunochemical test; NOAC, new oral anticoagulants; NSAIDs, nonsteroidal anti-inflammatory drugs; PEG, polyethylene glycol; SPMC, sodium picosulfate with magnesium citrate.
[a]*P* value < .05 (chi-square test for categoric data and analysis of variance for quantitative data).

Key Performance Measures Based on Endoscopic Procedure Indication

The adequate bowel preparation rate was less than 90% (86.6%) in general and was significantly lower in colonoscopies performed because of gastrointestinal symptoms (83.1%; odds ratio [OR], 0.62; 95% CI, 0.49–0.78) and surveillance (85.3%; OR, 0.71; 95% CI, 0.55–0.91). The CIR was 95.3% globally, but lower in symptomatic patients at 93.1% (OR, 0.34; 95% CI, 0.22–0.52); accordingly, inadequate bowel cleansing (36.3%) and the presence of neoplastic strictures (28.0%) were the main reasons for incomplete colonoscopy. The ADR was 38.0% globally, but with a huge variation regarding the indication of colonoscopy. In this respect, the ADR and polyp detection rate were higher in procedures as a result of +FIT (46.4%; OR, 2.01; 95% CI, 1.71–2.35; and 71.0%; OR, 1.98; 95% CI, 1.70–2.31, respectively) and postpolypectomy surveillance (48.2%; OR, 1.41; 95% CI, 1.20–1.67; and 62.8%; OR, 1.58; 95% CI, 1.35–1.86, respectively). Withdrawal time in colonoscopies without either a biopsy or therapy was statistically higher in procedures as a result of +FIT than in those resulting from other indications (9.8 ± 3.5 min; $P < .05$). The appropriate polypectomy technique rate was above the target standard recommendation (≥90%)[10] in general, and in all indications except postpolypectomy surveillance procedures (88.7%; OR, 0.52; 95% CI, 0.37–0.73). Finally, the polyp retrieval rate was higher than the target standard recommendation (≥95%),[10] with no statistical differences observed (Table 2).

Table 2. Key Performance Measures Based on Endoscopic Procedure Indication

			Endoscopic procedure indication				
	ESGE[10]	Total	Gastrointestinal symptoms	+FIT	Postpolypectomy surveillance	Primary screening colonoscopy	*P* value[a]
Rate of adequate bowel preparation, n (%)	≥90%[b] ≥95%[c]	12,875 (86.6)	4978 (83.1) OR, 0.62 (0.49–0.78)[d]	4834 (90.3) OR, 0.94 (0.73–1.20)[d]	1944 (85.3) OR, 0.71 (0.55–0.91)[d]	1119 (89.6) Reference	<.001
Cecal intubation rate, n (%)	≥90%[b] ≥95%[c]	14,168 (95.3)	5576 (93.1) OR, 0.34 (0.22–0.52)[d]	5175 (96.7) OR, 0.55 (0.34–0.87)[d]	2193 (96.2) OR, 0.68 (0.41–1.11)[d]	1224 (98.0) Reference	<.001
ADR, n (%)	≥25%[b]	5649 (38.0)	1683 (28.1) OR, 0.67 (0.58–0.79)[d]	2483 (46.4) OR, 2.01 (1.71–2.35)[d]	1098 (48.2) OR, 1.41 (1.20–1.67)[d]	385 (30.8) Reference	<.001
Withdrawal time, *min*, means ± SD	Mean, 6 min[b] Mean, 10 min[c]	8.4 ± 3.2	7.7 ± 2.7	9.8 ± 3.5[e]	7.7 ± 2.9	7.8 ± 2.7	<.001
Polyp detection rate, n (%)	40%[b]	8162 (54.9)	2405 (40.2) OR, 0.75 (0.65–0.86)[d]	3797 (71.0) OR, 1.98 (1.70–2.31)[d]	1431 (62.8) OR, 1.58 (1.35–1.86)[d]	529 (42.4) Reference	<.001
Appropriate polypectomy technique, n (%)	≥80%[b] ≥90%[c]	9789 (91.8)	2693 (95.0) OR, 1.26 (0.89–1.80)[d]	4672 (91.0) OR, 0.70 (0.50–0.96)[d]	1819 (88.7) OR, 0.52 (0.37–0.73)[d]	605 (93.3) Reference	<.001
Polyp retrieval rate, n (%)	≥90%[b] ≥95%[c]	5948 (96.2)	1522 (96.4) OR, 1.46 (0.83–2.56)[d]	3191 (96.3) OR, 1.30 (0.77–2.20)[d]	895 (95.6) OR, 1.18 (0.66–2.11)[d]	340 (95.2) Reference	NS

+FIT, positive fecal immunochemical test; ADR, adenoma detection rate; ESGE, European Society of Gastrointestinal Endoscopy; NS, nonsignificant difference; OR, odds ratio.
[a]$P < .05$ (chi-square test for categoric data and analysis of variance for quantitative data).
[b]ESGE recommendation of minimum standard.
[c]ESGE recommendation of target standard.
[d]Multivariate adjustment included sex, age, body mass index, comorbidities, and aspirin use. The 95% CI is shown.
[e]$P < .05$ vs other subcategories (Bonferroni test for multiple comparisons).

Figure 1 shows the ADR interval calculated using the exact Clopper–Pearson method and adjusted by sex, age, body mass index, comorbidities, and aspirin use for each indication. According to our results (Table 2), the ADR for primary screening colonoscopies was 30.8% (95% CI, 28.2%–33.5%), which is higher than the minimum standard recommendation according to ASGE[9] and ESGE[10] guidelines. The ADR was 48.2% (95% CI, 46.1%–50.3%) in surveillance after polyp excision, 28.1% (95% CI, 27.0%–29.3%) in symptomatic patients, and 46.4% (95% CI, 45.1%–47.7%) in +FIT colonoscopies. In addition, the ADR per indication remained invariable regardless of the ADR of the endoscopists who performed procedures in each indication, as reflected in the ADR trendlines for each indication (Supplementary Figure 1). Finally, the ADR also was calculated separately in men and women using the exact Clopper–Pearson method (Supplementary Figure 2).

Other Detection Rates Distributed by Colonoscopy Indication

+FIT colonoscopies had the highest adenoma per colonoscopy rate (2.63 ± 1.89; $P < .05$), but was similar to surveillance (2.49 ± 1.80); however, advanced ADR in +FIT procedures (26.3%; OR, 3.19; 95% CI, 2.53–4.01) was double that of surveillance (13.5%; OR, 0.93; 95% CI, 0.72–1.20). On the other hand, postpolypectomy surveillance colonoscopies had more serrated polyps (SDR, 18.5%; serrated polyp per colonoscopy rate, 2.21 ± 1.72) than other indications. Finally, colonoscopies owing to gastrointestinal symptoms had the highest CRC detection rate (5.1%; OR, 5.24; 95% CI, 2.30–11.93), followed by +FIT colonoscopies (4.5%; OR, 5.81; 95% CI, 2.55–13.26); the lowest CRC detection rate was observed in surveillance procedures (0.8%; OR, 0.83; 95% CI, 0.32–2.14) (Table 3).

Discussion

Colonoscopy plays a key role in CRC prevention and diagnosis. The efficacy of colonoscopy depends on the quality of the procedure; however, it remains unknown whether the fulfillment of these quality indicators shows the same behavior in the context of different colonoscopy indications. In this sense, the majority of quality recommendations have been made using primary screening colonoscopy as a benchmark.[5,9,10] However, practice in colonoscopy can vary widely, with endoscopists working in different conditions and

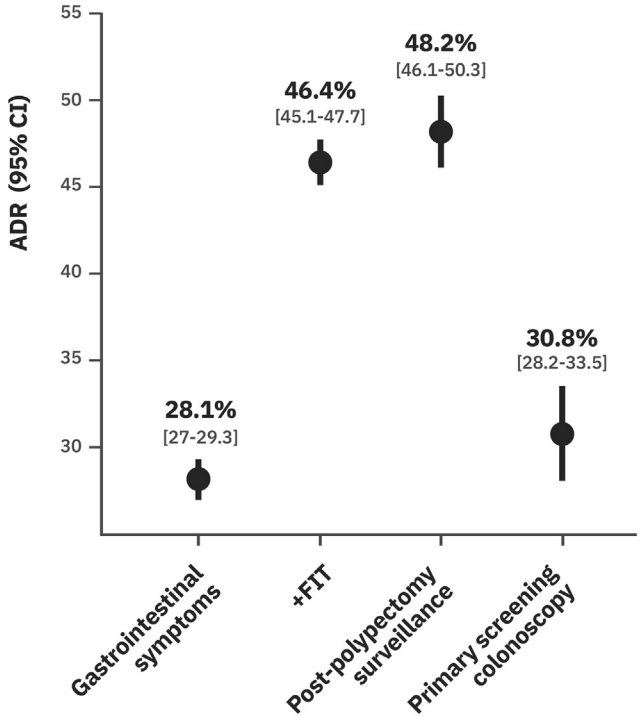

Figure 1. The Adenoma detection rate (ADR) and 95% CIs according to procedure indication and calculated using the exact Clopper–Pearson method. The ADR reported was adjusted by sex, age, body mass index, comorbidities, and aspirin use. +FIT, positive fecal immunochemical test.

with clinical practice that might be more focused in screening, surveillance, or symptomatic patients. In this study, we showed important and significant variation in the fulfillment of colonoscopy quality indicators according to indication. These differences in key performance measures are related not only to detection of pathology, but also to other indicators, such as the rates of adequate bowel preparation or cecal intubation. These results emphasize the importance of adapting the benchmarking measures to real clinical practice and environment, as well as the need to obtain different recommended quality indicators for different colonoscopy indications. In this study, we used a large number of procedures from different indications to set the relationship between key performance measures in different clinical settings.

We found notorious differences in bowel preparation across different indications, with the lowest rate of adequate bowel preparation in patients with symptoms (83.1%) and postpolypectomy surveillance (85.3%), and the highest in FIT-based screening procedures (90.3%). Similar results have been described previously.[11] Some characteristics of symptomatic patients have been associated previously with inadequate bowel preparation, such as older age and hospitalization: these patients were in worse condition than those undergoing screening or surveillance procedures. However, the adequate bowel preparation rate found in our study is generally poor and causes associated with this inadequacy will be addressed and analyzed in the future. We also found significant differences in the CIR, although all indications except procedures resulting from gastrointestinal symptoms (93.1%) reached the target standard recommendation.[10] In the majority of noncecal intubated procedures, this lower rate was because of inadequate bowel cleansing or the presence of neoplastic strictures.

Special consideration must be given to the ADR and other indicators related to detection of lesions. In our population, the ADR was higher in primary screening colonoscopy (30.8%) and almost doubled the

Table 3. Other Detection Rates Based on Endoscopic Procedure Indication

		Endoscopic procedure indication				
	Total	Gastrointestinal symptoms	+FIT	Postpolypectomy surveillance	Primary screening colonoscopy	*P* value[a]
APCR, means ± SD	2.46 ± 1.76	2.22 ± 1.57	2.63 ± 1.89[b]	2.49 ± 1.80	2.28 ± 1.43	<.001
Advanced ADR, n (%)	2468 (16.6)	626 (10.5) OR, 0.82 (0.64–1.04)[c]	1405 (26.3) OR, 3.19 (2.53–4.01)[c]	308 (13.5) OR, 0.93 (0.72–1.20)[c]	129 (10.3) Reference	<.001
SDR, n (%)	1858 (12.5)	551 (9.2) OR, 0.60 (0.48–0.75)[c]	733 (13.7) OR, 0.96 (0.77–1.19)[c]	422 (18.5) OR, 1.48 (1.18–1.85)[c]	152 (12.2) Reference	<.001
SPPCR, means ± SD	1.78 ± 1.32	1.63 ± 1.02[b]	1.63 ± 1.14[b]	2.21 ± 1.72	2.12 ± 1.57	<.001
CRC detection rate, n (%)	580 (3.9)	306 (5.1) OR, 5.24 (2.30–11.93)[c]	242 (4.5) OR, 5.81 (2.55–13.26)[c]	19 (0.8) OR, 0.83 (0.32–2.14)[c]	13 (1.0) Reference	<.001

+FIT, positive fecal immunochemical test; ADR, adenoma detection rate; APCR, adenomas per colonoscopy rate; CRC, colorectal cancer; OR, odds ratio; SDR, serrated polyp detection rate; SPPCR, serrated polyp per colonoscopy rate.
[a]$P < .05$ (chi-square test for categoric data and analysis of variance for quantitative data).
[b]$P < .05$ vs other subcategories (Bonferroni test for multiple comparisons).
[c]Multivariate adjustment including sex, age, body mass index, comorbidities, and aspirin use. The 95% CI is shown.

recommendations by the ASGE[9] and ESGE[10] guidelines for colonoscopy screening (ie, ≥25%) in FIT-based procedures (Figure 1). Cubiella et al[12] established a correlation between the ADR in primary and FIT-based screening colonoscopies and proposed an equivalent figure to the 20% ADR in the colonoscopy group that was 45% in FIT-based procedures. We have observed a similar relationship in which the ADR for +FIT colonoscopies was 46.4% (95% CI, 45.1%–47.7%) (Figure 1). These findings are concordant with those published previously by the Italian screening program in the Evaluating Quality Indicators of the Performance of Endoscopy study (ie, FIT-based),[13] the National Health System Bowel Cancer Screening Program in the United Kingdom (ie, guaiac-based),[14] and Wong et al[15] (ie, FIT-based), in which the ADR in screening programs was 44.8%, 46.5%, and 53.6%, respectively. In this respect, our data confirm the already proposed cut-off value of 45% or greater for FIT-based screening colonoscopies. Regarding the ADR, we can consider 2 different ranges with similar figures: on the one hand, procedures resulting from primary screening colonoscopy and gastrointestinal symptoms, and on the other hand, procedures performed because of +FIT screening and surveillance colonoscopy. In the first group, the ADR intervals are around 30% and in the second are ranges around 46%. However, there are substantial differences in the characteristics of these findings between different indications. Regarding the first group, the main difference between patients with primary screening colonoscopy and patients with symptoms lies in the highest detection of CRC in the latter indication, which does not correlate with a similar ADR between both indications. On the other hand, findings also were very different between +FIT and surveillance colonoscopy. Although this similarity in ADR and polyp detection rate found between surveillance and +FIT colonoscopies has been reported previously,[16,17] the advanced ADR in surveillance (13.5%) is half of that found in FIT screening procedures (26.3%), and the CRC detection rate in surveillance colonoscopies is the lowest detected in our population (0.8%). Therefore, the vast majority of adenomas found at surveillance were nonadvanced adenomas, highlighting the different yield of colonoscopy in both indications.

Regarding serrated polyps, there was wide variation in detection rates across endoscopists and centers, especially in the detection of sessile serrated polyps.[18–21] Presumably, this variation could be related to the wide interobserver agreement described between pathologists,[22] although this aspect was not addressed in our study. The SDR reported included hyperplastic polyps (≥5 mm or proximal to the sigmoid) as well as sessile or traditional serrated polyps. The SDR was 12.2% in screening colonoscopy and 18.5% in surveillance; these rates were higher than reported by Anderson et al,[22] who found 8% and 10%, respectively.

Our study had some strengths. We included a large number of colonoscopies, all performed by gastroenterologists and at various stages of their careers, therefore variability in individual ADRs is consistent with the literature. Procedures were included consecutively, and the nationwide characteristics of the study preserve some degree of homogeneity between centers and may be generalizable to other endoscopy practices. Previous studies have assessed data about some specific quality indicators and some procedure indication.[8,12–24] This study meticulously reported the highest number of quality indicators related to different procedure indications, and novel benchmarks to improve quality of colonoscopy are proposed.

This study also had some limitations. First, this was an observational, cross-sectional study, therefore it is difficult to determine the causes and effects of our results. The compliance of reporting colonoscopy data may be overestimated because endoscopists may be aware of the quality audit, which could lead to inaccurate results. In addition, our results in regard to diagnostic procedures may vary according to overall penetrance of population-based screening programs in each country. In Spain the penetrance of colonoscopy is lower compared with other countries, therefore detection rates might be overestimated in symptomatic patients.

In summary, this study found significant differences in fulfillment of key colonoscopy performance measures according to procedure indications. Although recommendations for primary screening colonoscopies are well established, these statements might be reconsidered in regard to indication. Although we are waiting for more prospective studies to validate our data, we reported reliable information as the starting point for quality indicators. Policies addressing performance measures beyond colonoscopy screening procedures may be developed to improve the overall quality of colonoscopy.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical Gastroenterology and Hepatology* at www.cghjournal.org, and at https://doi.org/10.1016/j.cgh.2019.08.035.

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Acknowledgments
The investigators of the QUALISCOPIA study are listed in the Appendix.

Conflicts of interest
The authors disclose no conflicts.

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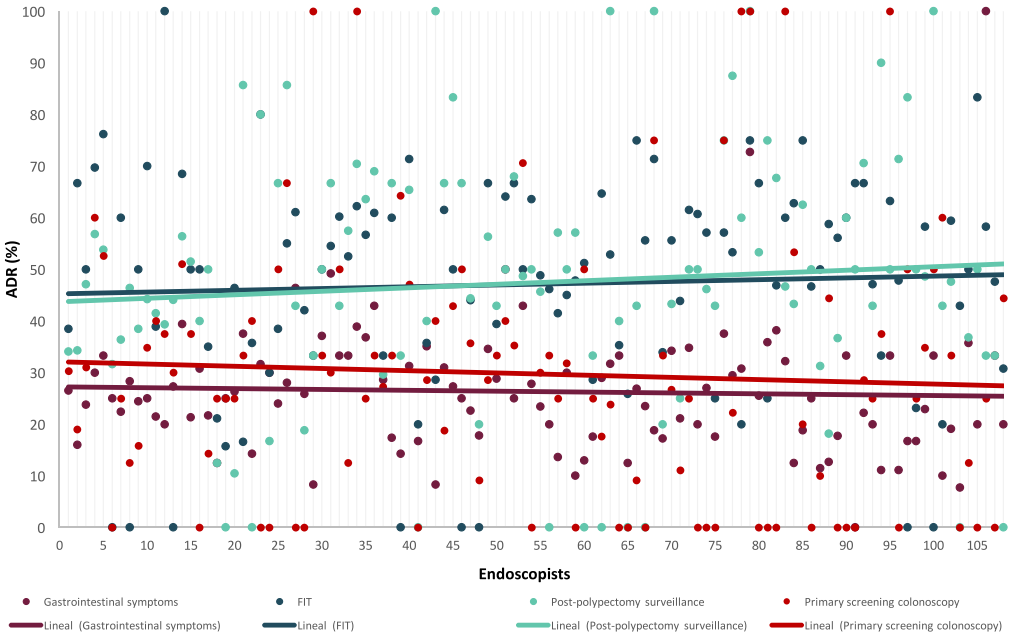
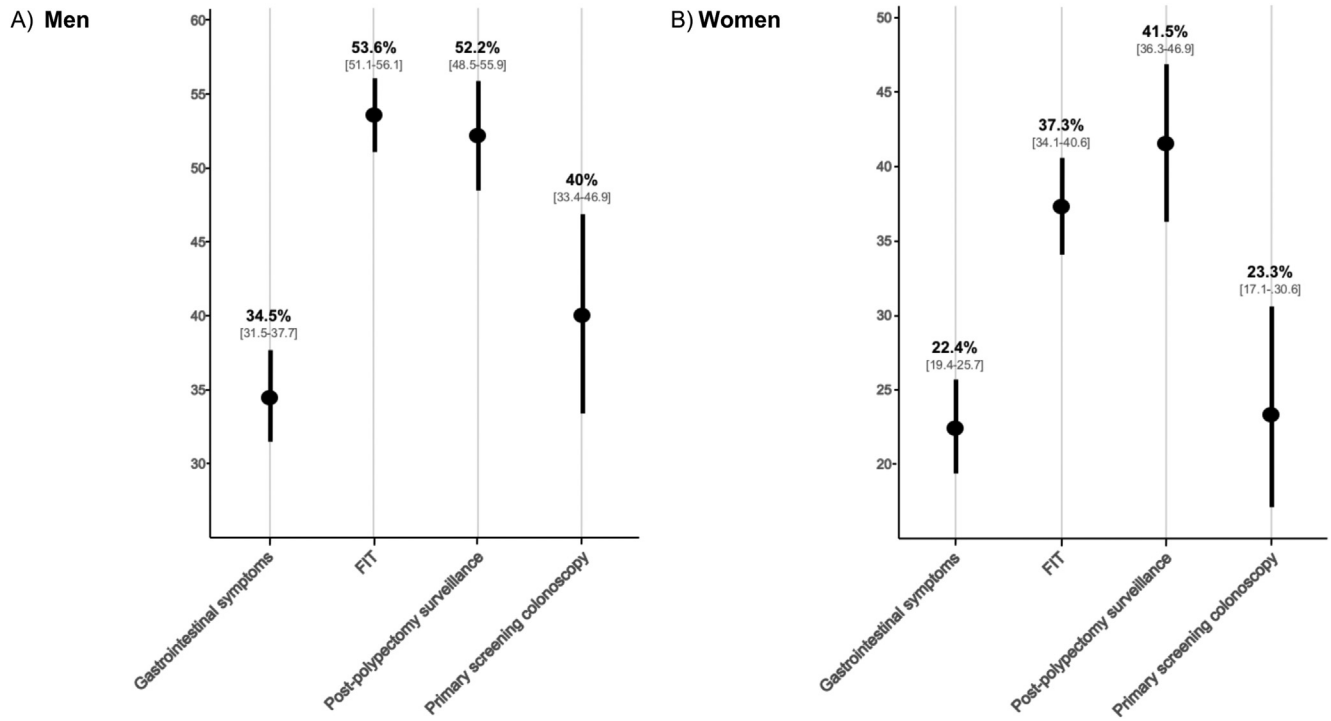
Appendix

Investigators of the QUALISCOPIA Study

The QUALISCOPIA Study investigators were as follows: Alicante: Rodrigo Jover, Carolina Mangas-Sanjuan, Enrique Santana, Juan A. Casellas, Francisco A. Ruíz-Gómez, Eva Serrano, and Cristina Mira; Asturias: Adolfo Suárez, Verónica Álvarez-García, Olegario Castaño, and Lorena Blanco; Canarias: Natalia González, Javier Lara, and Enrique Quintero; Hospital Clínic, Barcelona: María Pellisé, Liseth Rivero, Josep Llach, Henry Cordova, Isis Araujo, Ariadna Sánchez, Ingrid Ordas, and Karina Lisette; Hospital del Mar, Barcelona: Agustín Seoane, Marco Antonio Álvarez-González, Laura Carot, Inés Ana Ibáñez, Faust Riu, Miguel Pantaleón, Josep María Dedeu, and Luis Eugenio Barranco; Murcia: Akiko Ono; Ourense: Joaquín Cubiella, Elena Rodríguez-Camacho, Franco Baiocchi, and Coral Tejido; País Vasco: Luis Bujanda, Isabel Portillo, Isabel Idígoras, and Isabel Bilbao; Pamplona: Maite Herráiz, Cristina Carretero, and Maite Betés; Sevilla: Ángeles Pizarro; Valencia: Marta Ponce, Marco Bustamante, Vicente Pons, Lidia Argüello, and Carla Satorres; Valladolid: Pilar Díez-Redondo, Henar Núñez, and Victoria Busto; Vigo: Lucía Cid-Gómez, Vicent Hernández, Luisa de Castro, Nereida Fernández-Fernández, Alfonso Martínez-Turnes, Beatriz Romero-Mosquera, Romina Fernández-Poceiro; Zaragoza: Alberto Lué, Ángel Lanas, Angel Ferrández, and Pilar Roncales.



Supplementary Figure 1. Adenoma detection rate (ADR) trendlines for each indication according to endoscopists. FIT, fecal immunochemical test.



Supplementary Figure 2. Adenoma detection rate (ADR) and 95% CI according to procedure indication for (*A*) men and (*B*) women, calculated using the exact Clopper–Pearson method. The ADR reported is adjusted by age, body mass index, comorbidities, and aspirin use. FIT, fecal immunochemical test.