

## Utilization of colonoscopy in the United States: results from a national consortium

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**Background:** To assess capacity for colonoscopy, we need to understand current utilization of colonoscopy in diverse clinical practice settings. The objective of this study was to determine the utilization of colonoscopy in diverse clinical practice settings.

**Methods:** The Clinical Outcomes Research Initiative (CORI) data repository, which receives endoscopy reports from 73 diverse adult practice sites in the United States was used. Colonoscopy reports from January 2000 to August 2002 were analyzed to determine the demographic characteristics of adult patients who received a colonoscopy and the procedure indication. The relationship of age, race, gender, and procedure indication was analyzed.

**Results:** Results of colonoscopies in 146,457 unique patients were analyzed. Of the reports, 68% came from nonacademic settings. Patients less than 50 years of age accounted for 20% of colonoscopies. The most common indications were rectal bleeding (33.6%), irritable bowel symptoms (23.8%), or screening because of a positive family history of colorectal cancer (22.4%) and screening with a primary colonoscopy or a fecal occult blood test (FOBT) (12.8%). In patients 50 years and older, asymptomatic screening (average-risk screening colonoscopy, positive family history, or FOBT positivity) accounted for 38.1% of all colonoscopies. Surveillance colonoscopy in patients with previous cancer or polyps accounted for 21.9% of colonoscopies performed in this age group. Differences in utilization were noted, based on gender and race.

**Conclusions:** Colonoscopy utilization varies based on age, gender, and race. Colonoscopy often is performed in patients less than 50 years old for irritable bowel symptoms; rectal bleeding; or average-risk screening, for which benefits are uncertain. In patients older than 50 years, surveillance after polyp removal is a common indication and may be overused. Understanding utilization can lead to further study to determine outcomes, to optimize utilization, and to provide a basis for shifting limited resources. (*Gastrointest Endosc* 2005;62:875-83.)

The United States Preventive Services Task Force (USPSTF) and other expert panels have strongly recommended that average-risk adults, 50 years of age and older, receive colorectal cancer (CRC) screening.<sup>1-5</sup> The options include a fecal occult blood test (FOBT) and a sigmoidoscopy, which, if positive, lead to colonoscopy. The most recent recommendations also include average-risk screening with colonoscopy, and this option has been covered as a Medicare benefit since July 2001. Despite these recommendations and Medicare coverage, only 30% to 40% of the population over 50 years of age receives colon cancer screening.<sup>6</sup> There is concern that if colon cancer screening rates improve to 60% or 70%, the capacity to

perform colonoscopy procedures may be exceeded and current resources may be insufficient.<sup>7-10</sup>

To assess the capacity to perform colonoscopy in the United States, we need to understand current utilization. Specifically, it would be important to know why procedures are currently performed and the demographics of patients who receive a colonoscopy. This knowledge could identify specific situations where outcomes are uncertain or utilization is inappropriate. For example, a recent survey of physicians found that many physicians were performing colonoscopy surveillance inappropriately, and in excess of guidelines.<sup>11</sup> No prior study has measured utilization of colonoscopy in clinical practice settings in the United States. Utilization data could inform decisions to shift current resources to enable more capacity for screening.

The Clinical Outcomes Research Initiative (CORI) was established in 1995 to study utilization and outcomes of

endoscopy in diverse practice settings. Physician participants use a computerized endoscopic report generator to produce an endoscopic report and a simultaneous data file. After deletion of all patient identification, the file is transmitted electronically to a central data repository where it can be merged with data from multiple sites. Currently, more than 500 physicians in 73 practice sites, representing 24 states, send more than 220,000 endoscopic reports annually to the repository. Preliminary data with regard to indications for colonoscopy from 1997 to 1998 were previously reported.<sup>12</sup> We have observed a large increase in the utilization of colonoscopy screening as a proportion of endoscopic practice since 2000.<sup>13</sup>

The purpose of this analysis was to survey the CORI repository from January 1, 2000 to August 15, 2002, to determine utilization of colonoscopy and to measure demographic characteristics and indications of patients receiving a colonoscopy.

## PATIENTS AND METHODS

### CORI

Practice sites throughout the United States joined the CORI consortium from 1996 to 2001. Participating sites agreed to use a structured, computerized report generator to produce all endoscopic reports and to comply with quality-control requirements. The data file from the report is transmitted electronically to a central data repository, the National Endoscopic Database. All patient and physician identifiers are removed from the data file before transmission from the local site to protect both patient and physician confidentiality. The data are subjected to computerized quality-control checks to identify missing fields. Internalized quality control checks include parameters for size descriptions and drug dosage. After completion of quality-control checks, data from all sites are merged in the data repository for analysis. Site compliance is assessed annually. Sites provide record counts of procedures, which are compared with procedure counts in the data repository. If sites fail to record more than 90% of endoscopic reports by using CORI software, they are notified to improve compliance. Failure to improve compliance results in exclusion of the site's data from analysis.

### Colonoscopy utilization analysis

Complete colonoscopy reports received between January 1, 2000 and August 15, 2002, were included. We excluded reports in patients less than 20 years old. Race and ethnicity became a mandatory field in January 2001. Before that date, reporting of race was not always completed. The format for race and ethnicity was derived from the 2000 United States census. During the study period, race or ethnicity information for 12.3% of women and 12.5% of men was not reported. These records were

### Capsule Summary

#### What is already known on this topic

- Colonoscopy is increasingly used both for colorectal cancer screening and symptom evaluation.
- The CORI is a national database of endoscopic practices and outcomes in the United States.

#### What this study adds to our knowledge

- Colonoscopy often is performed in patients less than 50 years old, for irritable bowel symptoms, screening, and rectal bleeding for which benefits are uncertain.
- In patients older than 50 years, colonoscopic surveillance after polypectomy may be overused.

excluded from this analysis. Of reports, 1.7% had a incomplete field and were excluded. When patients had more than one examination during the study period, the first one was used for this analysis.

Indications for procedures were captured in the database. In many cases, there was more than one indication for the procedure. There was considerable overlap among the indications of abdominal pain, change in bowel habits, diarrhea, and constipation. We defined an irritable bowel syndrome (IBS) cluster to include one or more of the after symptoms: abdominal pain, bloating, change in bowel habits, diarrhea, and constipation. The IBS cluster excluded patients who underwent colonoscopy for surveillance of Crohn's disease, established Crohn's disease, surveillance of ulcerative colitis, established ulcerative colitis, weight loss, or bleeding (anemia or iron deficiency, positive FOBT, hematochezia, and melena).

### Statistical analysis

Colonoscopy indications were analyzed for patient groups based on age, gender, and race/ethnicity. Comparison of demographic data was performed by using chi-square tests. All analyses were performed with SAS software (SAS Institute Inc, Cary, NC).

## RESULTS

We received complete colonoscopy examination reports from 146,457 unique patients during the study period. Reports were received from private practice settings (68%), academic universities (20%), and Veterans Affairs (VA) medical centers (12%).

### Patient demographics

The demographic characteristics of the patients are described in [Table 1](#). Gender prevalence was determined for the non-VA practice sites, because the VA sites are predominantly men. When VA patients were excluded,

**TABLE 1. Patient demographics (total N = 146,457)**

Age, y	Women		Men		Proportion women, excluding VA, %
	N	% Total women	N	% Total men	
<50	16,257	22.4	13,510	18.3	57
50-59	20,644	28.4	21,267	28.8	55
60-69	16,783	23.1	18,970	25.7	54
70-79	14,027	19.3	15,495	21.0	55
≥80	4984	6.9	4520	6.1	58
Total	72,695		73,762		

  

Race/ethnicity	Women		Men		2000 U.S. Census,* %
	N	% Total women	N	% Total men	
White non-Hispanic	60317	83.0	62,915	85.3	69.1
Black non-Hispanic	6001	8.3	5262	7.1	12.3
Hispanic	4434	6.1	3770	5.1	12.5
Asian/Pacific Islander	1147	1.6	1160	1.6	3.7
Native American	719	1.0	573	0.78	0.9
Multiracial	77	0.11	82	0.11	1.6

VA, Veterans Administration.

\*In the 2000 U.S. Census, Hispanic ethnicity was collected and analyzed independent from race. Therefore, the data are not directly comparable, except for Hispanic but represent the proportion by race, not ethnicity.

55.0% of colonoscopies were performed in women. Among patients less than 50 years of age, women were more likely than men to undergo colonoscopy (22.4% of women vs. 18.3% of men;  $p < 0.001$ ). Patients over 80 years of age accounted for 6.5% of colonoscopy examinations. We compared the race and the ethnicity of our cohort with the 2000 United States Census (Table 1). White non-Hispanics accounted for 84% of examinations and appeared to be overrepresented in the group that received colonoscopy, compared with their proportion in the United States population.

### Indications for colonoscopy

Indications for colonoscopy varied based on age, gender, race, and type of clinical setting (Tables 2, 3, 4). The most common indications for colonoscopy in younger patients (<50 years of age) include hematochezia (33.6%) and a family history of CRC (19.4%). The IBS cluster accounted for 23.8% of procedures in patients less

than 50 years of age. In patients 50 to 74 years of age, the most common reasons for colonoscopy were hematochezia (19.9%), surveillance of polyps (17.4%), average-risk colonoscopy (12.9%), family history of CRC (14.1%), positive FOBT (11.5%), and IBS cluster (17.3%). In patients over 74 years of age, the single most common indication for colonoscopy was surveillance of prior adenomas (24.5%). Other common indications in older patients included hematochezia (16.1%), positive FOBT (13.6%), anemia/iron deficiency (12.8%), and IBS cluster (17.3%). Asymptomatic screening (defined as positive FOBT, family history of CRC, family history of polyps, and average-risk colonoscopy) accounted for 30.7% of colonoscopies in patients under 50 years old, 39.5% of procedures in patients 50 to 74 years of age, and 27.5% of procedures in patients over 74 years of age.

Among individuals receiving colonoscopy, there were differences in the procedure indication based on gender. Women are more likely to undergo colonoscopy for IBS cluster symptoms across all age groups (13.3% of men vs. 24.0% of women;  $p < 0.001$ ). Women also had a higher proportion of screening because of a positive family history of colorectal cancer than men (16.0% vs. 12.0%;  $p < 0.001$ ). Men had a higher proportion of colonoscopy for polyp surveillance (19.5% vs. 12.9%;  $p < 0.001$ ).

We analyzed patients separately according to their race or ethnicity (Table 3). The data are presented as proportions of colonoscopies for each indication within each racial group. Among whites, 36.2% were asymptomatic (average-risk screening, positive FOBT, or family history of CRC or polyps), compared with 34.0% of nonwhites ( $p < 0.001$ ). Among asymptomatic patients, a positive FOBT was more common in nonwhites than in whites (45.9% vs. 29.1%,  $p < 0.001$ ), whereas, a positive family history of colorectal cancer or polyps was a more common indication for whites (45.4% vs. 28.6%,  $p < 0.001$ ).

Evaluation of symptoms was more common in non-white groups compared with whites, including evaluation of anemia or iron deficiency (10.9% vs. 6.4%,  $p < 0.001$ ) and hematochezia (26.8% vs. 21.2%,  $p < 0.001$ ). Hispanics were more likely to have a colonoscopy to evaluate IBS symptoms than other races (20.8% vs. 18.4%,  $p < 0.001$ ); blacks were less likely to have colonoscopy for IBS symptoms than others (14.1% vs. 19.0%,  $p < 0.001$ ). Surveillance for prior adenoma was more common in whites compared with nonwhites (17.0% vs. 12.1%,  $p < 0.001$ ).

Procedure indication by practice site is shown in Table 4. The VA settings had higher rates of screening with a FOBT and lower rates of average-risk colonoscopy. The IBS cluster accounted for fewer colonoscopies in the VA setting. Few clinically important differences were noted between academic and nonacademic sites. Evaluation of inflammatory bowel disease (suspected or established) was more common at academic sites (2.6%), compared with nonacademic sites (1.1%) ( $p \leq 0.0001$ ).

**TABLE 2. Patient indications by gender and age**

	< 50 y		50-74 y		> 74 y	
	Women N = 16,257	Men N = 13,510	Women N = 45,142	Men N = 48,989	Women N = 11,296	Men N = 11,263
<b>Screening</b>						
Average-risk colonoscopy	157 (1%)	286 (2%)	5617 (12%)	6502 (13%)	861 (8%)	826 (7%)
Family history of colorectal cancer	3324 (20%)	2454 (18%)	7378 (16%)	5882 (12%)	917 (8%)	545 (5%)
Family history polyps	543 (3%)	333 (2%)	1150 (3%)	739 (2%)	74 (<1%)	31 (<1%)
Positive FOBT	1373 (8%)	1333 (10%)	4368 (10%)	6472 (13%)	1446 (13%)	1616 (14%)
<b>Surveillance</b>						
Surveillance of adenomatous polyps	854 (5%)	994 (7%)	6206 (14%)	10,198 (21%)	2354 (21%)	3170 (28%)
Surveillance of colorectal cancer	131 (<1%)	135 (1%)	1082 (2%)	1526 (3%)	782 (7%)	870 (8%)
Surveillance of ulcerative colitis	402 (2%)	476 (4%)	399 (<1%)	603 (1%)	67 (<1%)	96 (<1%)
Surveillance of Crohn's disease	292 (2%)	271 (2%)	256 (<1%)	249 (1%)	38 (<1%)	30 (<1%)
<b>Evaluation of symptoms</b>						
Hematochezia	4995 (31%)	5003 (37%)	8618 (19%)	10141 (21%)	1825 (16%)	1812 (16%)
Anemia or iron deficiency	1168 (7%)	622 (5%)	2652 (6%)	3051 (6%)	1432 (13%)	1456 (13%)
Melena	114 (<1%)	170 (1%)	303 (<1%)	510 (1%)	169 (2%)	246 (2%)
Weight loss	285 (2%)	305 (2%)	700 (2%)	800 (2%)	380 (3%)	411 (4%)
Suspected infectious colitis	26 (<1%)	28 (<1%)	40 (<1%)	28 (<1%)	10 (<1%)	7 (<1%)
Suspected IBD	376 (2%)	323 (2%)	200 (<1%)	133 (<1%)	33 (<1%)	17 (<1%)
Established ulcerative colitis	112 (<1%)	133 (<1%)	62 (<1%)	95 (<1%)	11 (<1%)	20 (<1%)
Established Crohn's disease	191 (1%)	113 (<1%)	70 (<1%)	97 (<1%)	8 (<1%)	13 (<1%)
IBS cluster*	4654 (29%)	2417 (18%)	10,358 (23%)	5884 (12%)	2431 (22%)	1473 (13%)

FOBT, Fecal occult blood test; IBD, inflammatory bowel disease; IBS, irritable bowel syndrome.

\*Defined as one or more of the following symptoms: diarrhea, constipation, abdominal pain/bloating, and change in bowel habits, excluding surveillance of Crohn's disease, established Crohn's disease, surveillance of ulcerative colitis, established ulcerative colitis, weight loss, or bleeding (anemia or iron deficiency, positive FOBT, hematochezia, or melena).

## DISCUSSION

This is the first study to characterize the utilization of colonoscopy in diverse clinical practice settings. Characterization of current endoscopic practice patterns can help inform decisions with regard to resource utilization. Unlike claims databases, the CORI repository provides a wealth of clinical information with regard to patient symptoms and findings. Unlike the Medicare database, the repository reflects the full spectrum of endoscopy across all age groups. Unlike research from academic settings with referral bias, most of the colonoscopy reports (68%) come from private practice settings. In contrast to survey data that report what physicians say they do,<sup>8,9</sup> CORI data reflect information for actual procedures performed. CORI data can highlight an indication with high utilization practices and raise questions for future research. This discussion will highlight a few key findings from this analysis.

### Patients less than 50 years old

This analysis finds that patients less than 50 years of age account for 20% of the colonoscopy procedures performed in adult GI practices. Most experts would agree that colonoscopy is indicated in young patients with a positive family history of CRC, surveillance of colorectal cancer, prior neoplasia, surveillance or evaluation of ulcerative colitis, or anemia or iron deficiency,<sup>3</sup> and these groups account for 34.6% of the examinations in patients less than 50 years old. In the remaining group of patients less than 50 years of age (65%), the procedure indications may be more controversial. This group represents a significant proportion (13.3%) of all colonoscopies performed during the study period.

An average-risk screening colonoscopy or a positive FOBT represented 12.8% of the examinations in the group of patients who were under 50 years of age. Colorectal cancer screening is not recommended until age 50 years in

**TABLE 3. Indications for colonoscopy by race/ethnicity**

	<b>White non-Hispanic N = 123,232</b>	<b>Black non-Hispanic N = 11,263</b>	<b>Hispanic N = 8204</b>	<b>Asian/Pacific Islander N = 2307</b>	<b>Native American N = 1292</b>	<b>Multiracial N = 159</b>
<b>Screening</b>						
Average-risk colonoscopy	12,104 (10%)	1051 (9%)	795 (10%)	201 (9%)	74 (6%)	24 (15%)
Family history of colorectal cancer	18,383 (15%)	1227 (11%)	587 (7%)	170 (7%)	114 (9%)	19 (12%)
Family history polyps	2660 (2%)	149 (1%)	31 (<1%)	20 (<1%)	6 (<1%)	4 (3%)
Positive FOBT	12,986 (11%)	1775 (16%)	1147 (14%)	531 (23%)	136 (11%)	33 (21%)
<b>Surveillance</b>						
Surveillance of adenomatous polyps	20,969 (17%)	1344 (12%)	1107 (13%)	229 (10%)	108 (8%)	19 (12%)
Surveillance of colorectal cancer	3822 (3%)	337 (3%)	246 (3%)	79 (3%)	37 (3%)	5 (3%)
Surveillance of ulcerative colitis	1864 (2%)	87 (<1%)	63 (<1%)	20 (<1%)	8 (<1%)	1 (<1%)
Surveillance of Crohn's disease	1025 (<1%)	65 (<1%)	35 (<1%)	2 (<1%)	8 (<1%)	1 (<1%)
<b>Evaluation of symptoms</b>						
Hematochezia	26,160 (21%)	2767 (25%)	2469 (30%)	546 (24%)	420 (33%)	32 (20%)
Anemia or iron deficiency	7845 (6%)	1452 (13%)	707 (9%)	190 (8%)	171 (13%)	16 (10%)
Melena	1231 (1%)	156 (1%)	72 (<1%)	26 (1%)	25 (2%)	2 (1%)
Weight loss	2189 (2%)	370 (3%)	223 (3%)	60 (3%)	37 (3%)	2 (1%)
Suspected infectious colitis	100 (<1%)	12 (<1%)	20 (<1%)	6 (<1%)	1 (<1%)	0 (0%)
Suspected IBD	918 (<1%)	64 (<1%)	72 (<1%)	23 (1%)	3 (<1%)	2 (1%)
Established ulcerative colitis	363 (<1%)	37 (<1%)	17 (<1%)	14 (<1%)	1 (<1%)	1 (<1%)
Established Crohn's disease	441 (<1%)	43 (<1%)	7 (<1%)	0 (0%)	1 (<1%)	0 (0%)
IBS cluster*	23,297 (19%)	1587 (14%)	1710 (21%)	357 (15%)	243 (19%)	23 (14%)

FOBT, Fecal occult blood test; IBD, inflammatory bowel disease; IBS, irritable bowel syndrome.

\*Defined as one or more of the following symptoms: diarrhea, constipation, abdominal pain/bloating, and change in bowel habits, excluding surveillance of Crohn's disease, established Crohn's disease, surveillance of ulcerative colitis, established ulcerative colitis, weight loss, or bleeding (anemia or iron deficiency, positive FOBT, hematochezia, or melena).

average-risk individuals. Prior studies show that the expected rates of significant neoplasia are low in asymptomatic patients under 50 years of age. Imperiale et al,<sup>14</sup> found that only 3.5% of an asymptomatic cohort, 40 to 49 years of age (with and without a family history of colon cancer), had advanced neoplasia defined as a polyp or a mass greater than 9 mm. The value of performing a FOBT or a screening colonoscopy in patients less than 50 years of age is unproven, and this practice is not

recommended by the USPSTF, the American Cancer Society, or the Multi-Society Task Force.<sup>1-3</sup>

IBS symptoms without signs of bleeding or weight loss accounted for 23.8% of examinations in patients less than 50 years of age. Women less than 50 years of age were more likely than men to have colonoscopy for IBS symptoms (28.6% vs. 17.9% of colonoscopies in this age group,  $p < 0.001$ ). Despite the low risk of malignancy in individuals under age 50 years of

**TABLE 4. Patient indications for colonoscopy by type of practice setting**

Indication category	Practice setting		
	Nonacademic n = 100243 n (%)	Academic n = 28908 n (%)	VA n = 17306 n (%)
Screening			
Average risk	10,050 (10.0)	3435 (11.9)	764 (4.4)
(+) Family history of CRC	15,250 (15.2)	3558 (12.3)	1692 (9.8)
(+) FOBT	10,838 (10.8)	2429 (8.4)	3341 (19.3)
Surveillance			
Prior adenoma(s)	16,241 (16.2)	4045 (14.0)	3490 (20.2)
Prior CRC	2969 (3.0)	902 (3.1)	655 (3.8)
Ulcerative colitis	1396 (1.4)	411 (1.4)	236 (1.4)
Crohn's disease	785 (0.8)	218 (0.8)	133 (0.8)
Evaluation of symptoms			
Hematochezia	21,980 (21.9)	6696 (23.2)	3718 (21.5)
Anemia or iron deficiency	6163 (6.2)	2133 (7.4)	2085 (12.1)
Melena	680 (0.7)	483 (1.7)	349 (2.0)
Weight loss	1786 (1.8)	612 (2.1)	483 (2.8)
Suspected infectious colitis	68 (0.1)	56 (0.2)	15 (0.1)
Suspected inflammatory bowel disease	632 (0.6)	354 (1.2)	96 (0.6)
Established ulcerative colitis	229 (0.2)	164 (0.6)	40 (0.2)
Established Crohn's disease	204 (0.2)	237 (0.8)	51 (0.3)
IBS cluster*	20,625 (20.6)	5211 (18.0)	1381 (8.0)

VA, Veterans Administration; CRC, colorectal cancer; FOBT, fecal occult blood test; IBS, irritable bowel syndrome.

\*Defined as one or more of the following symptoms: diarrhea, constipation, abdominal pain/bloating, and change in bowel habits, excluding surveillance of Crohn's disease, established Crohn's disease, surveillance of ulcerative colitis, established ulcerative colitis, weight loss, or bleeding (anemia or iron deficiency, positive FOBT, hematochezia, or melena).

age,<sup>15</sup> there may be benefits to ruling out malignancy and colonic inflammation. Further data are needed to determine if younger patients with IBS benefit from colonoscopy. In patients with abdominal pain or changes in bowel habits, it is possible that a negative procedure could relieve anxiety and inform subsequent management decisions. If physicians determine that the diagnosis of IBS requires the confident exclusion of GI pathology, colonoscopy could play an important role.

Hematochezia was an indication in 33.6% of colonoscopies performed in patients less than 50 years of age. The severity of bleeding is unknown in our study. Several studies have used colonoscopy to determine the risk of malignancy in patients with hematochezia.<sup>16-23</sup> These studies are plagued by inconsistent methods and reporting. There is no uniform definition to describe the amount

or the frequency of bleeding. It is not clear whether colonoscopy is indicated in patients less than 50 years of age and with minor bleeding. The current data highlight a utilization pattern that requires further study to determine if colonoscopy is the optimal procedure to evaluate hematochezia in patients less 50 years of age without a family history of CRC or if sigmoidoscopy would have been adequate. One prior study suggested that sigmoidoscopy would detect most important pathology in younger patients with hematochezia.<sup>23</sup>

### Patients 50 years of age and older

The risk of serious neoplasia increases with age in patients over 50 years.<sup>15,24,25</sup> Current screening recommendations include the use of colonoscopy as a screening test for asymptomatic individuals more than 50 years of age.<sup>1-5</sup> In our cohort, 37.2% of colonoscopies performed

in patients more than 50 years of age are for screening purposes: either primary screening colonoscopy with or without a family history of CRC or for a positive FOBT. These results are similar to surveys of physicians, which find that 39% to 46% of colonoscopies performed by GI physicians are for screening purposes.<sup>8,9</sup>

One consequence of increased screening is the detection of patients with polyps, who subsequently will be entered into surveillance programs. The current data highlight that surveillance colonoscopy after removal of adenomas is the single most common indication for colonoscopy in patients older than 50 years, accounting for 15.2% of procedures in women and 22.2% of procedures in men over 50 years of age. The benefits of frequent endoscopic surveillance are uncertain. The lifetime risk of colorectal cancer is 6%, whereas, the prevalence of adenomas is 30% to 50%, depending on age. Most patients with adenomas, therefore, will not benefit from surveillance. Recent guidelines have recommended a 3- to 5-year interval between examinations.<sup>3</sup> Nevertheless, a recent survey by the National Cancer Institute discovered that many physicians perform surveillance colonoscopy inappropriately, in excess of guidelines.<sup>11</sup> The survey found that more than 50% of gastroenterologists recommended surveillance for a single small adenoma every 3 years or more often and that 24% recommended surveillance after removal of a hyperplastic polyp. The current CORI data highlight an important utilization pattern but lack important information about surveillance intervals and prior endoscopic findings. Reduction in the frequency of surveillance in patients with small adenomas could increase the capacity to perform colonoscopy for screening. A prospective study in the CORI consortium is underway to measure outcomes based on surveillance intervals.

### Race/ethnicity

We found important differences in procedure utilization and outcomes based on race/ethnicity. We cannot determine if our data are representative of endoscopic practice in the United States, because there is no other database or repository for such data. Relative to their proportion in the United States population, blacks and Hispanics appear to be underrepresented in the CORI cohort (Table 1). This may reflect bias of the CORI sample or could be an accurate reflection of proportion of non-Hispanic blacks who receive endoscopy. Future analysis will compare our cohort over 65 years with the Medicare database to determine if we find a similar proportion of minorities over 65 years who receive colonoscopy.

The current data can be used to perform "within racial group" analyses of procedural indications to determine the proportion of patients within each group who undergo colonoscopy for specific reasons. Nonwhites are more likely to have colonoscopy to evaluate symptoms than whites. Specifically, anemia/iron deficiency and

hematochezia were more common as an indication for colonoscopy in nonwhites, compared with whites (36.4% vs. 27.1%,  $p < 0.001$ ). In contrast, asymptomatic screening was performed more commonly in whites than nonwhites (36.2% vs. 34.0%,  $p < 0.001$ ). If nonwhites do not receive colonoscopy until they have symptoms, they may be more likely to have serious advanced pathology than if they were undergoing screening examinations when asymptomatic. There is considerable evidence that black non-Hispanics have a higher risk of death from CRC than whites and Hispanics.<sup>15</sup> Prior studies suggest that blacks represent a high-risk group and should be targeted in screening efforts.<sup>26-29</sup> It is possible that nonwhites with access to medical care are not offered, do not seek, or do not accept screening examinations. This could lead to delays in diagnosis and the discovery of colon lesions in later stages of disease. Further study is needed to determine rates and stages of serious neoplasia in the white and nonwhite populations who receive colonoscopy.

### Limitations

There are several important limitations of the CORI data. Although the consortium was designed to mirror endoscopic practice in the United States, we cannot exclude the possibility of site-selection bias. CORI users from participating practice sites are comfortable with using computers for endoscopic reporting and sharing data from their respective practices. Such practices may differ in important ways from practices that will not share data or that do not use computerized databases to monitor quality in their practice. Some of the practices that participate in CORI use the computerized report generator in an ambulatory surgical center, instead of in the hospital, because of hospital policies involving information technology. Therefore, these data may not reflect the full spectrum of inpatient hospital procedures performed by the participants. Because most colonoscopy procedures are performed in an outpatient setting, the current data should provide a valid representation of outpatient colonoscopy. The relative proportion of procedures performed in academic vs. nonacademic sites may not reflect actual practice in the United States. Nonacademic sites accounted for 68% of the colonoscopy reports in this report. It is quite possible that nonacademic sites actually account for a higher proportion of colonoscopy procedures in the United States.

Some data may be incomplete or inaccurate. Race and ethnicity data are provided by the physician or the nurse. These data are not as accurate as direct patient entry. Indications for colonoscopy are provided by the physician by checking an item on a computer screen. Physicians may be parsimonious and enter some but not all reported symptoms or problems. The recorded indication may reflect "reimbursement bias." Physicians may be more likely to provide an indication that will lead to reimbursement from third-party carriers. For example, if

a carrier does not provide coverage for screening colonoscopy or for abdominal pain, the physician may be more likely to note rectal bleeding or some other acceptable indication. Because the indications for colonoscopy broaden to include screening, this potential bias should diminish.

The endoscopy report lacks clinical perspective. Prior diagnostic tests or treatments are unknown. With regard to colon adenoma surveillance, we do not know if the baseline lesion was an advanced adenoma or whether the previous examination was complete or compromised by poor bowel preparation. This information could strongly influence the decision to perform colonoscopy. Despite these important limitations, the CORI repository is a valuable hypothesis-generating tool. Observational snapshots of clinical practice identify important research questions that will require more precise data collection in prospective studies. Finally, analyses of such a large database can produce results that are statistically significant but may not be clinically important. In this discussion, we have highlighted the findings that we believe are clinically relevant.

What are the implications of this analysis? Experts have expressed concern<sup>7-10</sup> that the need for colorectal cancer screening in the United States exceeds the capacity, because of limited colonoscopy resources. However, capacity is dependent on how we use the resource. The current data provide the first practice-based analysis of colonoscopy utilization in the United States. In diverse practice settings, colonoscopy utilization varies based on age, gender, and race. This report highlights several utilization patterns that require further research to establish if there is benefit. First, colonoscopy is commonly used in patients less than 50 years old, many of whom do not have evidence-based indications for colonoscopy. For example, a FOBT screening or an average-risk screening colonoscopy accounted for nearly 13% of colonoscopies in this age group and is not recommended. IBS accounted for 23.8% and hematochezia for 33.6% of colonoscopies in patients under 50 years. Do young patients with these symptoms benefit from colonoscopy or would other, less-invasive evaluation be sufficient? Second, the most common indications for colonoscopy in patients older than 50 years are a prior history of polyps or cancer. Recent survey data indicate that many physicians perform surveillance at more frequent intervals than is recommended.<sup>11</sup> Extending surveillance intervals would have a large impact on colonoscopy workload. Finally, further study is needed to determine if black, non-Hispanics are receiving recommended colon cancer screening, because they have a higher risk of mortality from CRC. Understanding utilization and outcomes can lead to further study to measure optimal use of colonoscopy and to provide a basis for shifting resources to the screening of asymptomatic individuals.

## DISCLOSURE

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