Endoscopist Specialty Predicts the Likelihood of Recommending Cessation of Colorectal Cancer Screening in Older Adults

Audrey H. Calderwood, MD, MS^{1,2}, Joseph C. Anderson, MD^{2,3}, Christina M. Robinson, MS¹ and Lynn F. Butterly, MD^{1,2}

- OBJECTIVES:** Although the 2008 US Preventive Services Task Force guidelines recommend against routine colorectal cancer (CRC) screening for adults aged 76–85, it is unclear what endoscopists recommend in practice. Our goal was to examine current practice around cessation of CRC screening in older adults.
- METHODS:** We included normal screening colonoscopy exams in adults ≥ 50 years old within the New Hampshire Colonoscopy Registry between 2009 and 2014. The primary outcome was endoscopists' recommendation against further screening. The main exposure variables included patient age, family history of CRC, and endoscopist characteristics. Descriptive statistics and univariate and multivariable logistic regression models were used.
- RESULTS:** Of 13,364 normal screening colonoscopy exams, 2914 (21.8%) were in adults aged ≥ 65 and were performed by 74 endoscopists. Nearly 100% of adults aged 65–69 undergoing screening colonoscopy were given the recommendation to return for screening colonoscopy in the future. Only 15% of average-risk patients aged 70–74 were told to stop receiving screening, while 85% were told to return at a future interval, most frequently in 10 years when they would be 80–84. In the multivariable model, advancing patient age and the absence of family history of CRC were significantly associated with a recommendation to stop colonoscopy. Gastroenterologists were more likely to recommend stopping colonoscopy in accordance with guidelines than other non-gastroenterology endoscopists (adjusted OR (95% CI) 2.3 (1.6–3.4)).
- CONCLUSIONS:** In a large statewide colonoscopy registry, the majority of older adults are told to return for future screening colonoscopy. Having a family history of CRC or a non-gastroenterology endoscopist increases the likelihood of being told to return for screening at advanced ages.

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BACKGROUND

Colorectal cancer (CRC) is the second leading cause of cancer death in men and women in the United States (US). Because of the effectiveness of CRC screening in reducing the incidence of and mortality associated with CRC, ample research has focused on improving adherence to screening for CRC [1–3]. The “de-escalation” of screening, meaning the cessation of routine preventive screening in older adults when benefits may be minimal or outweighed by potential risks, is an emerging concept that will have increasing importance as the US population ages [4, 5]. Optimizing appropriate use of screening colonoscopy in older adults improves

care at the patient level, and importantly, at the system level, it may reduce costs and improve availability of colonoscopy for those in need of first-time screening. In 2008, the US Preventive Services Task Force (USPSTF) recommended that routine CRC screening stops after the age of 75 and that the decision to screen be individualized between the ages of 76 and 85 [6]. At that time, the USPSTF also recommended against routine screening in adults over 85 years old. Similarly, the US Multi-Society Task Force (USMSTF) on CRC recommends that persons who are up-to-date with screening and have negative prior screening tests be considered to stop screening at the age of 75 years [7]. In addition, the USMSTF recommends

¹Section of Gastroenterology and Hepatology, Dartmouth Hitchcock Medical Center, Lebanon, NH, USA. ²The Geisel School of Medicine at Dartmouth, Hanover, NH, USA. ³Department of Veterans Affairs Medical Center, White River Junction, Hartford, VT, USA. **Correspondence:** A.H.C. (email: audrey.h.calderwood@hitchcock.org)

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that persons without prior screening should be considered for screening up to the age of 85, depending on their life expectancy.

CRC screening recommendations in older adults can be inappropriately given [8]. Colonoscopy is currently the most utilized modality for CRC screening in the US [9], and the recommendations provided by endoscopists to patients and referring providers play a large role in screening behaviors [10]. The role of endoscopists in inappropriate use of screening colonoscopy in older adults has not been evaluated previously, and how endoscopists incorporate age in their recommendations for further CRC screening has yet to be described. In this study, we sought to examine current practice, including patient- and endoscopist-related factors, associated with endoscopist recommendations against further CRC screening in older adults.

METHODS

New Hampshire Colonoscopy Registry

The New Hampshire Colonoscopy Registry (NHCR) is a population-based, statewide registry collecting data from endoscopy sites throughout New Hampshire [11–14]. This study is a retrospective analysis of prospectively collected data between 2009 and 2014 from 74 endoscopists at 23 different sites. The Committee for the Protection of Human Subjects at Dartmouth College (study no. 00015834) and other relevant human subjects reviewing bodies at participating sites approved all data collection, study procedures, and informed consent forms. Before colonoscopy, patients provided informed consent and completed a self-administered patient questionnaire, including demographic factors (i.e., age, gender, marital status, and education), family history of CRC, behaviors (i.e., smoking, alcohol intake, and exercise), and perceived health (“excellent,” “very good,” “good,” “fair,” or “poor”). Immediately after the colonoscopy, the endoscopists complete both the NHCR procedure form (in some cases, dictating responses to the endoscopy nurse) and the clinical (medical) record (EMR) endoscopy report. The same author (endoscopist) is responsible for both documents, which are completed nearly simultaneously. Data collected include *indication for procedure*—with detailed options offered on the procedure form within each of the three indication categories of surveillance (for personal history of CRC or for personal history of polyps), diagnostic, and screening (including screening with positive family history of CRC)—*findings* (location and size of polyps or other lesions), *quality of bowel preparation*, *completion of examination*, and *recommendation for follow-up*. For all findings, the NHCR requested reports directly from the pathology laboratory used by each participating endoscopy facility. Trained NHCR staff verified and entered the pathology results into the NHCR database, linking pathology to individual polyps from the procedure form [12].

Inclusion criteria

We included normal (defined as no polyps or CRC) screening colonoscopy exams (as recorded on the NHCR procedure form) in patients aged ≥ 50 years within the NHCR. We excluded incomplete exams, those with inadequate bowel preparation, or those in

whom polyps or inflammation such as colitis were detected. Exams without polyps that identified diverticulosis or hemorrhoids were included. We evaluated exams performed by endoscopists with at least 100 screening colonoscopies in the NHCR in order to be able to have a reliable assessment of endoscopists’ adenoma detection rate (ADR) [15].

Definitions and outcomes

The indication of screening colonoscopy was determined using the NHCR procedure form “Indication for Procedure” field. The procedure form provides numerous detailed options for indication for procedure, to facilitate completion of the forms while ensuring accurate collection of clinically relevant data. For example, within the category of “surveillance,” options include “surveillance for personal history of colon cancer,” and “surveillance for personal history of polyps,” clearly distinguishing between *surveillance* colonoscopies conducted in patients with a personal history of either polyps or CRC, and *screening* colonoscopies. This analysis included only exams with the following two indications: “screening exam (no symptoms or family history)” and “screening exam for family history of colon cancer,” thereby excluding exams in patients with prior history of polyps.

Normal exams (i.e., without any polyps or other findings) were identified from the NHCR procedure form “Findings” field, for which a “Normal Exam” met the inclusion criteria. Complete exam was defined as to the terminal ileum or cecum, as abstracted from the “End of Procedure Status” field on the NHCR procedure form. Recommendations for follow-up were also obtained from the NHCR procedure form and included the following choices: follow-up colonoscopy in ≤ 1 year, 2–3 years, 4–5 years, 6–9 years, 10 years, or >10 years; or no further screening indicated. “Follow up with primary care provider (PCP)” was another choice on the NHCR procedure form that could be selected alone or in conjunction with a recommendation for follow-up colonoscopy. The “Follow-up with PCP” field was designed for endoscopists, who want their patients considered for follow-up colonoscopy at a future time (i.e., follow-up with a PCP who will evaluate medical appropriateness) and might nonetheless want to suggest what the appropriate follow-up interval would be in order to help the PCP decide when to consider the next colonoscopy.

We report “follow-up with PCP” separately from “no further screening indicated.” Other follow-up choices included additional testing (e.g., barium enema, CT colonography, etc.). Bowel preparation cleanliness was obtained from the NHCR procedure form field, which used standardized definitions for “excellent,” “good,” and “fair.” Fair was included based on prior work showing adequacy of polyp detection with this rating [16]. Exams with bowel preparations rated as “poor” were considered “inadequate” and excluded.

We calculated the ADR for each endoscopist in the NHCR. ADR was defined as the number of screening colonoscopies with at least one adenoma or adenocarcinoma detected, divided by the total number of screening colonoscopies during that time frame.

Our primary outcome was endoscopists’ recommendation against further screening. The secondary outcomes included factors

associated with recommendations against further screening and temporal trends. The main exposure variables included patient age and endoscopist characteristics, including ADR and specialty. Other variables were patient gender, body mass index (BMI), family history of CRC (as completed by the provider on the NHCR procedure form), smoking, alcohol, exercise, marital status, education, and endoscopist gender and years since completion of training.

Main analysis

We used descriptive statistics, chi-square test for trend, and Fisher's exact test to evaluate categorical variables. Wilcoxon rank sum test was used for nonparametric continuous variables. Most analyses were performed separately for average-risk patients and those with a family history of CRC. Time trends by calendar year were performed using the Cochrane–Armitage test for trend. We performed univariate analyses and a multivariable logistic regression model. The multivariable model included all factors found to have an association with the outcome (i.e., a recommendation to stop further screening colonoscopy), defined as $P < 0.10$ in univariate analyses. We tested for an interaction between age and family history in terms of the recommendation to stop screening colonoscopy by including an interaction term in the model. Because of the concern for potential collinearity between endoscopist ADR and specialty, the multivariable model was run, including each variable without the other and then both together. The model with both variables together fit the best (as determined by the R^2). The analyses were conducted in SAS (SAS 9.4 System Options; SAS Institute Inc. 2015, Cary, NC).

Supplementary analysis

We replicated the main analyses limiting the bowel preparation cleanliness to “excellent” and “good” (and excluding “fair”) to evaluate the effect of preparation cleanliness on our results. We evaluated endoscopists' recommendation against further screening among the “fair” preparation category alone.

Sample size estimate

We based our sample size estimate on assumptions around the difference in the rate of patients receiving a recommendation to stop screening by age. We estimated that 1–10% of patients between the age of 50 and 69 and 30–70% of patients aged ≥ 70 would receive recommendations to stop screening. In order to detect this difference with 80% power at the $\alpha = 0.05$ level, we would need anywhere from 24 to 62 patients per age group, which was easily attainable within the NHCR cohort.

This study was reviewed and approved by the Dartmouth IRB (Committee for the Protection of Human Subjects) as nonhuman subjects research in February 2017.

RESULTS

There were 13,364 normal, complete, and adequately prepared screening colonoscopy exams in NHCR between 2009 and 2014, of which 2914 (21.8%) were in adults aged ≥ 65 (Fig. 1). Approximately 62% of all patients were female and 18.3% reported a family

history of CRC. Perceived health was very similar between both age groups. Overall, 25.2% reported excellent, 43.7% very good, 27.2% good, 3.6% fair, and only 0.34% poor health. The colonoscopies were performed by 74 endoscopists, of which 53 were gastroenterologists, 18 were surgeons, and 2 were family medicine. The majority were male. Median (IQR) ADR was 24.4% [18.9–29.8]. Table 1a and b shows the characteristics of the patients and endoscopists in our cohort, respectively. Supplementary Table 1 shows characteristics of the patients limited to excellent and good bowel cleanliness.

Table 2 shows the rates of endoscopists recommending cessation of CRC screening stratified by patient age and family history of CRC. Nearly 100% of adults between the ages of 50 and 69 undergoing screening colonoscopy were recommended to return for another screening colonoscopy in the future. Among the average-risk patients, recommendations against further screening increased with age: 15.5% among those aged 70–74, 40.8% among those aged 75–79, and 65.1% among those aged 80 and older. Recommendations against further screening also increased with patient age among those with a family history of CRC; however, the trend was delayed by 5 years: 1.1% among those aged 70–74, 14.1% among those aged 75–79, and 53.6% among those 80 and older. There was a significant increase in receiving a recommendation to follow up with PCP with advancing age (age 50–64: 0.59%, 65–79: 0.74%, 80–84: 3.2%; 85–89: 5.0%, ≥ 90 : 4.4%; p for trend < 0.0001), although overall use of this recommendation was low.

The majority of average-risk patients recommended for future colonoscopy were given a 10-year follow-up interval (Table 2a). For example, among average-risk patients aged 75–79 who had a normal screening colonoscopy, 86.6% of those who were told to return for a repeat colonoscopy were told to do so in 10 years, when they would be 85 years or older.

The majority of patients with a family history of CRC recommended for future colonoscopy were given a 5-year follow-up interval, consistent with guidelines (Table 2b) [17].

Bowel preparation cleanliness seemed to impact endoscopist recommendations in specific ways. Average-risk patients with fair preparation were more likely to be given a recommendation to return for earlier colonoscopy (within 5 years), compared with those with excellent or good preparation (Supplementary Tables 2 and 3); however, those with fair preparation were equally likely to be told to stop colonoscopy with increasing age, compared with those with excellent or good preparation. Among patients with a family history of CRC, those who underwent colonoscopy with fair preparation were less likely to be recommended to stop colonoscopy than those with excellent or good preparation.

Figure 2 shows the temporal trends for recommendations against future colonoscopy by age and calendar year. There was a significant increase in the percentage of patients recommended for no further colonoscopy between 2009 and 2014 in the 65–69-year-old (0–4.4%, $P = 0.04$), 70–74-year-old (2.5–17.1%, $P < 0.0001$), 75–79-year-old (21.7–29.4%, $P = 0.03$), and 80 and above (66.7–100%, $P = 0.04$) age groups.

Table 3 shows the results of univariate analyses and the multivariable model. In univariate analyses, older age (OR [95% CI] = 65–69

Fig. 1 Flow diagram of screening colonoscopies in adults of age 65 and older in the New Hampshire Colonoscopy Registry. ^aThree colonoscopies were excluded because of the selection of multiple “other follow-up recommendations”. ^bThese colonoscopies include exams in which something other than a polyp, such as patchy inflammation, was biopsied. To ensure that our analysis included only normal exams with no findings, these exams were excluded

years: ref, 70–74 years: 10.5 [6.5–17.1], 75–79 years: 42.1 [26.2–67.7], and ≥80 years: 132.5 [77.4–227.0]), family history of CRC (0.28 [0.19–0.41]), and being married (0.62 [0.49–0.80]) were associated with the recommendation against further colonoscopy among older adults. BMI (as a continuous variable) was also significant, such that for every one-point increase in BMI, there was a decreased odds of a recommendation against colonoscopy (OR 0.95 [0.93–0.98]). There was no significant association with patient-reported perceived health. In terms of endoscopist factors, higher ADR (OR 1.02 [1.0–1.03]) and specializing in gastroenterology (OR 1.9 [1.4–2.6]) were also associated with the recommendation against further colonoscopy among older adults. There was no significant association with endoscopist gender or experience, as measured by years since completion of training.

In the multivariable model, which included age (in 5-year brackets), family history of CRC, marital status, endoscopist ADR (≥25% vs. <25%) and endoscopist specialty, advancing age (adjusted OR (95% CI) = 65–69 years: ref, 70–74 years: 9.7 [5.9–15.8], 75–79 years: 39.3 [24.0–64.1], and ≥80 years: 163.0 [91.1–291.8]), and family history of CRC (adjusted OR 0.20 [0.13–0.32]) remained significantly associated with a recommendation against further colonoscopy. Gastroenterologists were more likely to recommend stopping colonoscopy than other non-gastroenterology endoscopists (adjusted OR 2.3 [1.6–3.4]). There was no interaction between age and family history ($p=0.06$). In a multivariable model limited to exams with excellent and good preparation, age, family history of CRC, and gastroenterology specialty were significantly associated with a recommendation against further colonos-

Table 1 Characteristics of the patients (a) and endoscopists (b) in the New Hampshire Colonoscopy Registry screening cohort

a. Patients		
Characteristics	Age < 65 N (%)	Age ≥ 65 N (%)
Total	10450 (78.2)	2914 (21.8)
Age, years, median [IQR]	53.0 [51–59]	69 [66–73]
Female	6419 (61.4)	1805 (61.9)
Family history of colorectal cancer	1785 (17.1)	664 (22.8)
BMI, median [IQR] ^a	27 [24–31]	26 [24–30]
Smoking ^a		
Never	5982 (59.4)	1370 (49.2)
Past	3444 (34.2)	1336 (48.8)
Current	638 (6.3)	78 (2.8)
Alcohol, drinks per week ^a		
None	3501 (35.0)	1110 (40.1)
1–4	3872 (38.7)	880 (31.8)
≥ 5	2644 (26.4)	777 (28.1)
Some exercise ^a	9368 (92.9)	2587 (93.2)
Marital status ^a		
Single	779 (7.8)	143 (5.2)
Married	7771 (77.6)	2066 (74.5)
Other	1467 (14.7)	566 (20.4)
Education ^a		
High school or less	2458 (23.5)	804 (27.6)
Some college	7992 (76.5)	2110 (72.4)
Perceived health ^a		
Excellent	2561 (25.4)	663 (24.0)
Very good	4419 (44.0)	1187 (42.9)
Good	2683 (26.7)	803 (29.0)
Fair	350 (3.5)	109 (3.9)
Poor	39 (0.39)	5 (0.18)
Bowel cleanliness		
Excellent	3964 (38.0)	1084 (37.2)
Good	5711 (54.7)	1573 (54.0)
Fair	765 (7.3)	257 (8.8)
b. Endoscopists		
Characteristics	N (%)	
> 20	34 (46.6)	
Specialty ^b		
Gastroenterology	53 (72.6)	
Surgery	18 (24.7)	
Family medicine	2 (2.7)	
Adenoma detection rate, %		
Median [IQR]	24.4 [18.929.8]	
< 25	40 (54.1)	
25–34.9	25 (33.8)	
≥ 35	9 (12.2)	

b. Endoscopists		
Characteristics	N (%)	
> 20	34 (46.6)	
Specialty ^b		
Gastroenterology	53 (72.6)	
Surgery	18 (24.7)	
Family medicine	2 (2.7)	
Adenoma detection rate, %		
Median [IQR]	24.4 [18.929.8]	
< 25	40 (54.1)	
25–34.9	25 (33.8)	
≥ 35	9 (12.2)	

BMI body mass index, IQR interquartile range
^aMissing data for BMI (*n* = 593), smoking (*n* = 516), alcohol (*n* = 580), exercise (*n* = 500), marital status (*n* = 572), and perceived health (*n* = 545)
^bMissing data for years in practice (*n* = 1) and specialty (*n* = 1)

Table 2 Endoscopist recommendations to stop colonoscopy and to return for further colonoscopy with a follow-up interval provided, stratified by patient age and family history of colorectal cancer

a. Average risk, n = 10,450						
Age	N	Recommendation to stop colonoscopy (%)	Follow-up interval given among those recommended for further colonoscopy (%)			
			≤ 3 years	4–5 years	10 years	
50–64	8665	0.07	0.42	8.4	91.4	
65–69	1241	1.7	0.33	8.6	91.1	
70–74	567	15.5	0	8.4	91.7	
75–79	316	40.8	1.1	12.3	86.6	
≥ 80	126	65.1	2.3	18.2	79.5	
b. Family history of colorectal cancer, n = 2449						
Age	N	Recommendation to stop colonoscopy (%)	Follow-up interval given among those recommended for further colonoscopy (%)			
			≤ 3 years	4–5 years	10 years	
50–64	2003	0	32.5	76.5	21.0	
65–69	410	0	1.1	79.0	19.9	
70–74	205	1.1	1.1	79.7	19.2	
75–79	95	14.1	2.7	75.3	21.9	
≥ 80	30	53.6	0.0	61.5	38.5	

copy (Supplementary Table 4). In addition, in this model limited to excellent and good preparation, higher BMI (adjusted OR 0.96 [0.93–0.99]) and good preparation (compared with excellent;

Fig. 2 Time trend of recommendations for no further screening colonoscopy by age

adjusted OR 0.68 [0.50–0.92]) were significantly associated with being less likely to receive a recommendation to stop colonoscopy.

DISCUSSION

In a large statewide colonoscopy registry, including 74 endoscopists, increasing age appears to influence recommendations against further screening, yet still the majority of patients who are 65 and older and even 75 and older are told to return for screening colonoscopy in 10 years when they would be 75 or older and 85 or older, respectively. There was an overall significant increase in recommendations to stop colonoscopy over the time period of the study, 2009–2014. Having a family history of CRC increased the likelihood of being told to return for screening at advanced ages and recommendations to stop in those with a family history of CRC appear to lag about 5 years, compared with average-risk adults without a family history of CRC. This is likely based on awareness that family history of CRC, especially in first-degree relatives, is a strong risk factor for CRC, and guidelines recommend earlier and more frequent screening colonoscopy in the setting of family history of CRC [17]. In addition, non-gastroenterology endoscopists were much less likely to recommend cessation of screening among older adults compared with gastroenterologists. Gastroenterologists may be more familiar with and have greater knowledge around screening guidelines compared with other specialties because of the large role screening colonoscopy likely plays in their clinical practice and thus may be more comfortable recommending against further screening. Among older adults recommended to return for future screening colonoscopy, the recommendations for the timing of follow-up after normal colonoscopy appear concordant with current guidelines on appropriate intervals (5 years for family history and 10 years for average risk) [17]. Bowel preparation cleanliness did appear to affect recommendations: average-risk adults with fair preparation were more likely to be given a shorter interval of follow-up (i.e., earlier than 10 years), compared with those with excellent or good preparation, and adults with a family history and fair preparation were less likely to be given a recommendation to stop colonoscopy at older ages, compared to those with excellent or good preparation.

Interestingly, perceived health was not associated with recommendations to stop screening colonoscopy. In our cohort, the majority of patients felt that they were in excellent, very good, or good health, and perhaps this influenced their decision to attend screening colonoscopy. The endoscopists may not have perceived the difference in patient-reported health status of excellent, very good, and good, in which case this would not have impacted their recommendations.

The risks of colonoscopy, including the preparation, sedation, and procedure itself, are increased in older adults, especially those with comorbid health conditions and limited mobility [18–21]. Specifically, there is a greater risk of electrolyte disturbances and dehydration from bowel preparation, sedation-related cardiopulmonary complications such as aspiration and cardiac arrhythmias, and higher risk for bleeding and bowel perforation. In terms of risk for CRC, the prevalence of colonic neoplasia (i.e., adenomas and CRC) increases with age, yet screening colonoscopy in older adults results in limited extension of life expectancy, especially when compared to use of colonoscopy in younger adults. Lin et al. estimated that the prevalence of colonic neoplasia was 13.8% in the 50- to 54-year-old group, compared with 26.5% in the 75- to 79-year-old group, and 28.6% in the group aged 80 years or older [22]. Because of competing causes of mortality, despite increased cancer incidence, the risk of CRC death has been estimated to decline with advancing age [23]. For example, men aged 85–89 in the 75th percentile for life expectancy (i.e., healthiest patients) have a risk of CRC death of 2.7% compared with 4.1% in those aged 50–54 and 3.8% in those aged 70–74 [24]. Lin et al. estimated that the mean extension in life expectancy was much lower in the group aged 80 years or older than in the 50- to 54-year-old group (0.13 vs. 0.85 years) [22]. Cooper estimated the number needed to screen with colonoscopy to prevent one CRC death to be 42 in men aged 70–74 compared with 133 in those aged 85–89 [23].

Our study includes data from 2009 to 2014, after the publication of the 2008 USPSTF guidelines. Still, it is very possible that endoscopists were unaware of the 2008 USPSTF recommendations, since there is evidence that it takes physicians up to 10 years to adopt guidelines into clinical practice [25, 26]. More recently in 2016, the USPSTF updated their CRC guidelines to state that screening between ages 76 and 85 should be selectively offered on an individualized basis, taking into account overall health, prior screening history, and patient preference. This was given a Grade C recommendation, meaning that CRC screening should be offered for select patients depending on individualized circumstances because of “at least moderate certainty that the net benefit is small.” [6] Because the data in this study were from 2009 to 2014, we cannot comment on whether and how the 2016 guidelines have been integrated into clinical practice.

For patients, while continuing cancer screening is easily accepted, stopping cancer screening may be viewed as a big decision and in fact, patients may have less trust in their physician if he or she recommends to stop screening [27]. Furthermore, even while patients may be amenable to stop cancer screening, especially in the context of a trusting relationship with their clinician, they may not understand the role of life expectancy and may pre-

Table 3 Patient and endoscopist-level factors associated with recommendation against further colorectal cancer screening among adults of age 65 and older

Variable	Likelihood of receiving a recommendation against further colorectal cancer screening			
	Unadjusted OR [95% CI]	P-value	Adjusted OR [95% CI]	P-value
Patient factors				
Age				
65–69	Ref		Ref	
70–74	10.5 [6.5–17.1]	0.0004	9.7 [5.9–15.8]	<0.0001
75–79	42.1 [26.2–67.7]	<0.0001	39.3 [24.0–64.1]	<0.0001
≥80	132.5 [77.4–227.0]	<0.0001	163.0 [91.1–291.8]	<0.0001
Female (vs. male)	0.92 [0.73–1.2]	0.47	n/a	
Family history of CRC	0.28 [0.19–0.41]	<0.0001	0.20 [0.13–0.32]	<0.0001
BMI	0.95 [0.93–0.98]	0.0002	0.97 [0.94–1.0]	0.06
Smoking				
Never	Ref			
Past	0.95 [0.75–1.2]	0.37	n/a	
Current	0.59 [0.25–1.4]	0.25		
Alcohol, drinks per week				
None	Ref			
1–4	0.97 [0.74–1.3]	0.78	n/a	
≥5	1.0 [0.76–1.3]	0.88		
Some exercise (vs. none)	0.91 [0.58–1.4]	0.68	n/a	
Married (vs. not married)	0.62 [0.49–0.80]	0.0002	0.79 [0.59–1.1]	0.99
Some college (vs. ≤ HS)	0.88 [0.69–1.1]	0.33	n/a	
Perceived health				
Excellent	Ref			
Very good	1.1 [0.82–1.5]	0.26		
Good	1.1 [0.80–1.5]	0.28	n/a	
Fair	0.82 [0.41–1.6]	0.10		
Poor	5.4 [0.89–32.8]	0.07		
Bowel cleanliness				
Excellent	Ref			
Good	0.78 [0.61–0.97]	0.14	n/a	
Fair	0.87 [0.57–1.3]	0.96		
Endoscopist factors				
Gender				
Female (vs. male)	0.76 [0.53–1.1]	0.13	n/a	
Years since training	0.99 [0.98–1.00]	0.26	n/a	
ADR				
Continuous	1.02 [1.00–1.03]	0.003	n/a	
ADR ≥ 25% (vs. < 25%)	1.3 [1.1–1.7]	0.01	1.25 [0.92–1.7]	0.15
GI (vs. other specialty)	1.9 [1.4–2.6]	<0.0001	2.3 [1.6–3.4]	<0.0001

ADR adenoma detection rate, BMI body mass index, CI confidence interval, GI gastroenterologist, OR odds ratio

fer not to hear about life expectancy when discussing screening [28]. For physicians, there may be difficulty in making decisions on when to stop cancer screening. Lewis et al. conducted focus groups and qualitative interviews with physicians to understand how physicians make decisions about CRC screening in adults aged 75 and older [29]. They found that physicians report difficulty with these decisions because of complexity and uncertainty around estimates of life expectancy. A multilevel framework has been suggested for discussions around cancer screening cessation in older adults [30].

A survey of over 1200 physicians from a mix of specialties using patient scenarios that varied patient age and illnesses found that 25% of primary care physicians recommended CRC screening for an 80-year-old patient with advanced lung cancer who would likely not benefit from screening [31]. As observed in our study, these authors also found that the likelihood of recommended CRC screening for patients 80 and older was associated with physician specialty; obstetrics–gynecology physicians were more likely than other specialties to recommend CRC screening for 80-year-old patients. Interestingly, physicians who had access to electronic medical records were less likely to recommend screening of elderly patients with severe illness. In a smaller survey of Veterans' Administration (VA) primary care providers, 21% of primary care providers recommended screening for a 75-year-old or older patient with active cancer and 15–17% recommended screening for a 75 or older patient “with limited life expectancy” from severe co-morbidities [32]. Provider characteristics, including specialty, did not influence these responses. One claim-based VA study evaluated over 27,000 patients aged ≥ 70 due for CRC screening, finding high rates of CRC screening among patients with metastatic tumors or severe comorbidity [33]. While this study did not evaluate provider specialty, it did show that the number of visits to primary care, gastroenterology or surgery predicted the likelihood of being screened independent of comorbidity. It is possible that endoscopists may have multiple reasons for recommending ongoing screening colonoscopy in older adults, including lack of knowledge or belief in guidelines, fear of missing cancer, or medicolegal concerns, and these reasons are worthy of further exploration [34].

Communication between endoscopists and PCPs around screening recommendations is important [10, 35]. Endoscopists must navigate the balance between giving explicit recommendations to return in 10 years (which may be interpreted by the PCP as definitely needing to come back) and having patients and PCPs reassess the risks and benefits of repeat screening colonoscopy based on changes in interval health and even emerging data closer to the time when the next colonoscopy would be due. It therefore may behoove endoscopists to give more subtle, nuanced recommendations about reassessing health status in 10 years to determine the benefit of screening at that time, as opposed to simply providing a timing of the next interval in general. Certainly, if current health status (e.g., oxygen dependence and severe heart failure) can predict that a screening colonoscopy in 10 years will be of low utility and higher risk, endoscopists should recommend against further screening.

The strengths of our study include the use of a large statewide colonoscopy registry, the NHCR, that prospectively collects comprehensive information on procedure indication, family history, findings, and follow-up recommendations. NHCR includes a large number of endoscopists, as well as numerous practices and different practice settings throughout New Hampshire. While New Hampshire is a small state, because NHCR is a population-based registry, it has very little selection bias and in fact, statewide efforts funded through the Center for Disease Control and Prevention (CDC) have improved access to CRC screening across NH, thus adding to the diversity of participants captured in the registry. Our study is unique in that we focused on the recommendations of endoscopists, whereas previous studies have looked mostly at primary care provider behavior. This is important because endoscopy recommendations strongly influence primary care providers [10].

Despite these strengths, we acknowledge certain limitations. Our information is limited to the data collected directly through NHCR; we do not have access to information about other modalities of CRC screening (other than as an indication), or other patient factors such as co-morbidities and patient function that could impact recommendations. Information about medical decision-making occurring outside of the data collection forms of the NHCR is not available. For example, if endoscopists had individualized discussions about re-visiting the concept of screening colonoscopy in 10 years, our data may not have captured this nuanced discussion. However, endoscopists did have the option of recommending follow-up with the primary care provider along with an interval for the next colonoscopy in cases where they wanted the primary care provider to consider colonoscopy in the future. In addition, the registry provides a general picture of current practice and trends over time that is informative and important despite any inherent limitations. A formal validation study (comparing the NHCR procedure report form to the endoscopy report in the clinical record) was not feasible, given constraints in time and funding. However, the same author (endoscopist) completes both the NHCR procedure form and the endoscopy report for the clinical (medical) record within minutes of completing the colonoscopy; therefore, the chances of significant differences or inaccuracies are very slim. In fact, to illustrate the comparability between the NHCR procedure form and the clinical endoscopy report, some participating sites have asked if they could use the NHCR procedure form as the endoscopy report in the clinical record. Furthermore, the outcomes are used for quality reporting and endoscopists understand that they are fully responsible for the accuracy of the data submitted. NHCR captures data in the state of New Hampshire, and thus further studies are needed to determine the generalizability of our findings. Our analysis focused on older adults with a normal screening colonoscopy. We excluded those with polyps to ensure the integrity of our analysis; however, it would be interesting to examine the impact of age on recommendations for surveillance colonoscopy among those with adenomas or other significant findings.

In summary, in a large statewide colonoscopy registry, increasing age appears to influence recommendations against further

screening colonoscopy, yet a majority of older patients are still given recommendations to return for screening colonoscopy when they would be above the age of 75 and even 85. Family history and specialty of the performing endoscopist played a role. Targeted education for endoscopists of all specialties regarding the risks and benefits of CRC screening in older adults and providing a framework in which to de-escalate screening may reduce use of screening colonoscopy in older adults, who may not benefit due to existing health conditions and overall life expectancy. Optimizing CRC screening in older adults will help maximize benefits and minimize harms, and in addition, it will improve the availability of colonoscopy for those of all ages in need of first-time screening.

DISCLAIMER

The contents of this work do not represent the views of the Department of Veterans Affairs or the United States Government.

CONFLICT OF INTEREST

Guarantor of the article: Audrey H. Calderwood.

Specific author contributions: Conception and design of the study: A.H.C., J.C.A., and L.F.B.; acquisition of data: A.H.C. and C.M.R.; analysis and interpretation of data, critical revision of the paper, and approval of the final version of the paper: A.H.C., J.C.A., C.M.R., and L.F.B.; statistical analysis, drafting of the paper, and study supervision: A.H.C.

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Potential competing interests: None.

Study Highlights

WHAT IS CURRENT KNOWLEDGE

- ✓ Optimizing appropriate use of screening colonoscopy in older adults is important.
- ✓ The US Preventive Services Task Force (USPSTF) in 2008 recommended against routine CRC screening in adults aged 76–85.
- ✓ Cessation of screening in older adults has implications for high-value care and colonoscopy capacity.

WHAT IS NEW HERE

- ✓ Most patients ≥ 65 and even ≥ 75 after normal screening colonoscopy are told to return for screening colonoscopy in 10 years when they would be ≥ 75 and ≥ 85 , respectively.
- ✓ Family history of CRC increased the likelihood of being told to return for screening at advanced ages.
- ✓ Gastroenterologists are more likely to recommend cessation of screening among older adults compared with non-gastroenterologists.
- ✓ There was an increase in recommendations to stop colonoscopy in patients of advanced age between 2009 and 2014.

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