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Overutilization of endoscopic surveillance in non-dysplastic Barrett's Esophagus: A multi-center study

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Abstract

Background—Guidelines suggest that patients with non-dysplastic BE undergo endoscopic surveillance every 3–5 years, but actual utilization of surveillance endoscopy and the determinants of variation in surveillance intervals are not known.

Objective—To measure utilization of surveillance endoscopy and its variation in patients with non-dysplastic BE.

Design—Multi-center, cross-sectional study

Setting—Three sites in Arizona, Minnesota, and North Carolina.

Patients—Participants had prevalent BE without a history of high grade dysplasia or EAC.

Interventions—Participants were given validated measures of quality of life, numeracy, and cancer risk perception, and the total number of prior endoscopic surveillance exams was measured.

Main outcome measurements—Over-surveillance was defined as >1 surveillance exam per 3 year period.

Results—Among 235 patients with non-dysplastic BE, 76% were male and 94% Caucasian. The average duration of BE was 6.5 years (± 5.9 years). The mean number of endoscopies per 3 year period was 2.7 (± 2.6 years). Over-surveillance was present in 65% of participants, resulting in a mean of 2.3 excess endoscopies per patient. Neither numeracy skills nor patient perception of cancer risk were associated with over-surveillance.

Limitations—Endoscopies were measured by patient report, which is subject to error. Results may only be generalizable to patients seen in academic centers.

Conclusions—Most patients with non-dysplastic BE had more surveillance endoscopic exams than is recommended by published guidelines. Patient factors did not predict over-surveillance, indicating that other factors may influence decisions about the interval and frequency of surveillance exams.

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Keywords

Barrett's esophagus; endoscopic surveillance; utilization; overutilization; esophageal cancer; non-dysplastic

Introduction

Barrett's esophagus (BE) is a premalignant condition involving a metaplastic transformation of the lower esophageal lining from squamous to intestinal epithelium, which is associated with an increased risk of esophageal adenocarcinoma (EAC) [1, 2]. The risk of EAC in persons with non-dysplastic BE is roughly 0.5% per year [3–5]. However, this incidence is 30–125 times than that of the general population because EAC is a rare cancer [3, 4]. Despite the increased relative risk of EAC associated with BE, longitudinal studies have failed to demonstrate increased mortality associated with BE [6, 7].

Endoscopic surveillance of BE with esophagogastroduodenoscopy (EGD) is controversial due to lack of evidence that BE is linked to increased mortality, and the lack of proven benefit of surveillance programs. Nevertheless, based on the theory that treatment of intermediate dysplastic lesions halts the progression to EAC and offers the potential to mitigate the risk of EAC, guidelines suggest that patients with BE should undergo periodic endoscopic surveillance, typically once every 3–5 years following initial diagnosis, if no dysplasia is present [8–13].

There is a gap in the published literature regarding how endoscopic surveillance is practiced in patients with BE, and how such guidelines are adhered to in practice. The few studies that have been published on this topic are primarily from physician surveys of practice patterns [14–19], which do not necessarily represent the patient experience. To that end, we sought to measure endoscopic utilization in a large population of nondysplastic BE patients from multiple geographic sites and practice settings. In addition, we aimed to identify predictors of over or under-utilization of endoscopic surveillance including demographic factors, quality of life, healthcare numeracy, risk perception, and other health behaviors.

Methods

Study design and setting

This was a multi-center, cross-sectional study of patients with non-dysplastic Barrett's esophagus. Participants were recruited from outpatient gastroenterology and endoscopy clinics at sites in Arizona (Southern Arizona Veterans Administration Medical Center (SAVAMC), Tucson, AZ), Minnesota (Mayo Clinic, Rochester, MN) and North Carolina (University of North Carolina (UNC) Hospitals, Chapel Hill, NC). Because all sites are tertiary referral centers, patients recruited for this study did not necessarily have their BE diagnosis or endoscopic surveillance at the site at which they were recruited. This study was approved by each site's institutional review boards. The coordinating site was the Center for Esophageal Diseases and Swallowing at UNC, and the central data repository was located within the Center for Gastrointestinal Biology and Disease at UNC.

Participants

Eligible participants were aged 18–80 and able to read and understand both the consent form and study surveys. For inclusion, participants had to have prevalent BE for greater than 6 months with either no dysplasia or a single past transient reading of low grade dysplasia (LGD). BE was defined as any endoscopically detectable upward displacement of the squamocolumnar junction in to the tubular esophagus of greater than 5mm, with at least one

biopsy specimen from the area demonstrating specialized columnar epithelium with goblet cells on routine pathology specimens. Subjects with goblet cells on biopsy, but no endoscopic appearance of BE, were not eligible for inclusion. Transient LGD was defined as a reading of LGD on a single biopsy specimen, with at least 1 subsequent endoscopy negative for dysplasia. Participants were excluded if they had a history of high grade dysplasia (HGD) or EAC, endoscopic ablation of BE, esophageal resection, or an active malignancy (except non-melanoma skin cancer). It was the practice of all three sites to maintain all subjects with prevalent BE on proton pump inhibitor therapy. Subjects were enrolled from October 2003 through April 2009. All participants provided written informed consent prior to participation.

Study data

Patients were given a survey to collect demographic information, and other study data including use of the internet for health information, duration of BE, and number of visits to healthcare providers per year. Participants were also given a measure of disease-specific quality of life (GERD-HRQL [20]), a measure of generic quality of life (SF-36 [21]), a validated eight-item numeracy scale to assess their ability to understand discussions of numerical risks [22](Supplementary Table A), and a previously-validated risk perception tool to measure patients' estimates of their one-year risk of EAC [23] (Supplementary Figure A). A 1 year risk of EAC of 0.5 – 1% per year was used as the standard risk estimate. Participants were also asked how often they worry about BE (based on a 5 point Likert scale, where 1="not at all" and 5="almost all the time"), and about their current severity of heartburn (assessed with a 5 point Likert scale where 1="no heartburn" and 5="really bad heartburn").

Measurement of endoscopic utilization

Participants were asked the number of times and dates they underwent surveillance endoscopies. Since patients with a history of endoscopic ablation were excluded, all post-diagnosis endoscopies were presumed to be for surveillance purposes. To ensure a focus on surveillance endoscopic exams, only participants with BE for at least 6 months were included in the utilization analysis. For bivariate and multivariate analysis, over-surveillance was defined as >1 EGD per 3 year period. We allowed and did not count a single confirmatory endoscopy within 1 year of the initial BE diagnosis. Excess endoscopies were calculated using the following formula:

$$[(\#\,\text{reported surveillance endoscopies}) - (1 + 0.33^{*}(\text{years of BE})]$$

Statistical analysis

Sample size calculations were performed based on preliminary data. Previous data demonstrated that 63% of patients with nondysplastic BE overestimated their 1 year risk of esophageal cancer, and overestimators underwent an average of 0.14 additional surveillance endoscopies per year compared to non-overestimators, with a standard deviation of 0.3 endoscopies for both groups [24]. In order to detect if the patient's perception of cancer risk was associated with the number of endoscopies they underwent (at an alpha of 0.05 and with 80% power), we estimated that we would need to enroll 100 over-estimators and 58 non-over-estimators. To allow for variability in the mixture of over-estimators and non-overestimators of risk by site, as well as to compensate for any decrement in the effect size noted in our preliminary data, we planned to enroll a total of 240 patients (80 per site).

Exploratory data analysis was performed to examine the distribution of continuous and categorical values, and to determine missing or implausible values. Bivariate analysis was then performed to identify variables associated with over utilization of endoscopic surveillance, using Student's t-tests for continuous variables, and Pearson's Chi-squared

tests or Fisher's exact tests for categorical variables. Multivariate logistic regression modeling was then performed to estimate odds ratios (OR) and 95% confidence intervals (95% CI) for factors independently associated with over-surveillance, including non-collinear variables significantly related to the outcome in bivariate analyses using p value of ≤0.10, and limiting the model to M/10 components (beta coefficients + intercept), where $M=[3*(n_1)(n_2)]/n$ (where n_1 and n_2 are the number of subjects in each group, and n is the total number of subjects). Covariates in the model included study site, insurance status, duration of BE, heartburn severity, physician visits per year, and use of internet for information on BE. Subjects with missing data on the dependent or independent variables were excluded. A p value of <0.05 and 95% CI that did not include the null value were considered statistically significant unless otherwise indicated. All statistical analyses were performed using STATA, version 10.1 (College Station, TX, USA).

Results

Participants

Demographic information is shown in Table 1. A total of 236 patients were recruited, but 1 participant dropped out before completing the study questionnaire, and thus excluded from the analysis. Overall, 76% were male and 94% Caucasian. Mean age was 62 (± 11.5). Most patients were well-educated, with 95% reporting at least a high school degree. Roughly 1/3rd of patients came from each site. The mean duration of BE was 6.5 years (± 5.9); approximately half had BE for 5 or more years.

Endoscopic surveillance utilization

Amongst the194 participants with data on endoscopic surveillance, there were a total of 785 surveillance endoscopies performed. Use of endoscopic surveillance is shown in Table 2, stratified by site. On average, participants had a surveillance endoscopy every 20.2 months following their BE diagnosis. Using published guidelines as benchmarks [8–12], patients had substantially more surveillance endoscopies than even the most aggressive guidelines, with 1.8 endoscopies per 2 year period. Using a cutoff of >1 endoscopy per 3 year period (excluding a single confirmatory endoscopy), 65% of all participants experienced excess endoscopic surveillance (Figure 1). When a more conservative cutoff of >1 endoscopy per 2 year period was used (again excluding a single confirmatory endoscopy), 45% of participants exceeded the recommended surveillance interval. Even after excluding those reporting transient LGD in the past (which may have led to increased frequency of surveillance examinations), most participants (57%) still experienced over-surveillance (>1 per 3 year interval). All told, there was an excess of 233 surveillance exams among the 102 BE patients who were over-surveyed, yielding a mean number of excess endoscopies of 2.3 per patient throughout the duration of their BE diagnosis.

Bivariate and multivariate analyses

Bivariate analysis of factors associated with over-surveillance is shown in Table 3. Although all sites demonstrated significant rates of over-surveillance, over-surveillance did significantly vary by site, with UNC having the highest proportion of over-surveillance compared to Mayo and SAVAMC (40% vs. 30% and 29% respectively, p=0.005). Patients with private insurance were more likely to experience over-surveillance than either Medicare or VA populations (53% vs. 22% and 23%, respectively, p=0.04). Those with over-surveillance generally had BE for fewer years compared to those without over-surveillance, but this was not statistically significant (6.1 years vs. 7.7 years, p=0.1). Use of the internet for information on BE was more common in those with over-surveillance vs. those without, but this did not reach statistical significance in our sample (67% vs. 52%

respectively, p=0.07). There was no significant difference between groups with respect to cancer risk perception or numeracy.

Results of multivariate analysis are shown in Table 4. While there were trends towards increased odds of over-surveillance associated with having private insurance and using the internet for BE information, none of the examined factors were significantly associated with over-surveillance. A subgroup analysis of subjects from non-VA sites only (i.e. UNC and Mayo) revealed similar results (Supplementary Table B).

Discussion

In this multi-center study, we found that endoscopy in the setting of non-dysplastic Barrett's esophagus was overutilized. Oversurveyed BE patients had on average 2 excess endoscopies over the duration of their BE. A rigorous assessment of patient-related variables did not identify any demographic factors, health behaviors, numeracy skills, quality of life indicators, or symptom severity measures that predicted over-surveillance in multivariate analysis.

The health belief model [25] is a social cognitive model that has been developed to help explain health behaviors. This model suggests that four basic elements underlie and explain health behavior, including perceived risk, severity, benefits, and barriers. It is within this context that we measured certain health behaviors and attitudes that could predispose to over-surveillance, including cancer risk perception and numeracy, quality of life and symptom severity, and healthcare utilization. Unfortunately, the lack of a strong association of any of the patient characteristics with over-surveillance argues that interventions directed towards patients may not be effective in counteracting this phenomenon.

Screening for and surveillance of BE are controversial topics given the rarity of EAC, and the fact that neither screening nor surveillance have proven to reduce disease-specific or overall mortality [6, 7, 26]. Nevertheless, guidelines generally recommend that patients with nondysplastic BE undergo endoscopic surveillance at regular intervals (i.e. every 3–5 years following diagnosis). Up to 90% of BE patients have non-dysplastic disease [27], so the patients in this study represent the majority of those with BE who are enrolled in surveillance programs. Given that the cancer risk is lowest in those with non-dysplastic disease, endoscopic surveillance in general would be presumed to be least beneficial in such patients, and, given the large numbers of such patients, "over-surveillance" is most problematic in this setting. Therefore, understanding whether patient factors contribute to over-surveillance is important.

Few studies have examined this issue, and studies that have been published on this topic are predominantly physician surveys focused on provider attitudes and understanding or adherence to guidelines. Our data are in agreement with previous physician surveys reflecting the desire for frequent endoscopic surveillance on the part of caregivers. In a survey of 434 US gastroenterologists performed in 2000, Falk et al. reported that most respondents recommended a surveillance interval of 2 years for those with no dysplasia (64%), while 24% recommended more frequent (annual) surveillance exams [15]. In a survey of 154 gastroenterologists in 2001, Cruz-Correa et al. reported that 65% of respondents recommended a surveillance interval of 18–24 months for those with non-dysplastic BE, while 28% recommended a surveillance interval of 7–12 months. Only 5% of respondents recommended a surveillance interval of 3 years for this group [14]. Surveys of physicians in Canada [16], Ireland [17], Scotland [18], and the Netherlands [19] reveal similar results, with wide variation in practice patterns and generally poor reported adherence to published guidelines. To our knowledge, this is the first published study to

measure whether patient factors may be associated with increased frequency of endoscopic surveillance in BE.

We found evidence in bivariate analyses that patients' insurance status and site of care may contribute to frequency of endoscopic surveillance. Endoscopic surveillance in the single payer VA system most closely adhered to published guidelines. We also found that having private insurance was associated with over-surveillance. The reasons for such associations may be related to medico-legal concerns, reimbursement issues, or other provider factors. A 2002 survey of 103 Californian gastroenterologists found that up to 30% of respondents performed surveillance endoscopy despite believing it was neither efficacious or cost-effective, citing medicolegal concerns as a chief reason for this practice, in addition to procedure reimbursement and patient preference [28]. In another survey of US gastroenterologists in 2008, Rubenstein et al. found that physicians who were prior defendants in malpractice suits recommended more frequent endoscopic surveillance [29]. Taken together, these results suggest that over-surveillance may be more common in privately-insured patients and that the endoscopist's fear of liability due to missing dysplasia or cancer may play an important role in dictating frequency of surveillance. Similar to previous work [24], a large proportion of patients in this study over-estimated their risk of cancer; however this over-estimation of risk was not significantly associated with over-surveillance.

Our findings parallel those of recent studies measuring overutilization of other gastroenterological procedures. In a study of over 3600 participants enrolled in a colorectal cancer screening trial, Schoen et al. found that overuse of surveillance colonoscopy was common: among subjects with an initial negative screening exam, 26.5% underwent a second surveillance colonoscopy within 5 years despite the fact that a 10 year interval is generally recommended in this setting [30]. In a study of utilization of upper endoscopy for gastric ulcers in the US, Saini et al. found that 25% of ambulatory patients with gastric ulcer had "surveillance EGDs" within 3 months of the index endoscopy (presumably to document ulcer healing), despite the fact that this practice has not been shown to improve outcomes and is not generally recommended [31]. In addition, wide variation in practice patterns and guideline adherence has been described in inflammatory bowel disease [32–34], liver disease [35, 36], and colorectal cancer screening practices [37, 38] in the US. Our study provides further evidence that within the field of gastroenterology, there exists variation in care, with some patients getting too much. Reduction in such variation towards more consistent evidence-based and guideline-directed practices is a key prerequisite to achieving better and more cost-effective healthcare [39–41].

This was a multi-center study which measured the surveillance experience of a large number of non-dysplastic BE patients. The study sites represented 3 different settings of practice including a public hospital (UNC), a private hospital (Mayo Clinic) and a VA facility (SAVAMC), which improves the generalizability of our results. However, since all 3 sites are academic medical centers, these findings may not be representative of community practice. Our sample contained relatively few patients with low household incomes and/or no insurance, so our results may not be generalizable to these populations. However, since BE is more common in higher socioeconomic strata [42], our study subjects are likely a reasonable representation of the typical Barrett's population. We used a structured questionnaire and validated measurement tools for data collection. We evaluated a robust number of potentially important patient factors as possible contributors to overutilization of endoscopic surveillance including demographic factors, health behaviors, quality of life measures, numeracy skills, and risk perception.

We acknowledge that decisions about endoscopic surveillance are complex. Additionally, some EGDs that we labeled as "over-surveillance" may have been done for other clinical reasons, and not solely motivated by cancer prevention. These patients might be expected to suffer from an increased amount of reflux symptoms compared to the general population. It is unlikely, however, that symptom-driven investigations account for the marked excess of endoscopies seen in this study, given that we compared the reported symptom severity in patients with excess endoscopy to those with appropriate surveillance and did not find increased reflux symptoms in those with excess endoscopy. Nevertheless, our findings suggest that overutilization is quite common, and does not seem to be strongly related to any of the numerous patient factors we measured. There are certain patient factors that we did not measure that are potentially important, however, such as use of acid-suppression medication and length of Barrett's segment.

Endoscopic exams were measured by patient report for several reasons. Firstly, previous work by our group and others has validated that self report is highly correlated with actual examinations with a sensitivity of 90% or higher for identifying performed endoscopies [24, 43, 44]. Secondly, this study involved 3 study sites that are tertiary referral centers and thus the reported endoscopic exams for many of the patients occurred at different institutions than that of the study site. For this reason, ascertainment by medical records at each study site would not have captured all surveillance exams. Thirdly, while self report may be subject to misreporting, there is no reason to suspect that over-reporting would be more common than under-reporting. Lastly, even if there was some over-reporting of surveillance endoscopies, it is unlikely that measurement bias would be substantial enough to explain the >200% surplus of surveillance exams we report. The retrospective design of this study may have resulted in under-enrollment of those who are surveyed at longer intervals and underestimation of surveillance intervals. However, a sensitivity analysis artificially enriching the population with subjects surveyed at longer intervals demonstrated that this bias is unlikely to nullify our finding of surplus surveillance exams (Supplementary Table C). Although non-participation was low in this study, information on the exact number of subjects who declined participation and reasons for non-participation is not available, making detection bias a possibility.

In conclusion, we have found that overutilization of endoscopic surveillance is common in non-dysplastic BE, even using the most liberal definition for an "indicated" exam. Over-surveillance does not appear to be related to factors such as age, gender, altered risk perception, patients' anxiety, numeracy, quality of life or symptom severity. Private insurance was associated with an increased likelihood of excess endoscopy. Whether overutilization of endoscopic surveillance is related to non-patient factors such as medicolegal concerns or other endoscopist characteristics is a fertile area for future study. These data also suggest that improved physician adherence to guidelines regarding endoscopic surveillance of non-dysplastic BE is needed so that healthcare resources can be better allocated to areas with more proven benefits.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Acronyms

BE	Barrett's esophagus
EAC	Esophageal adenocarcinoma
EGD	esophagogastroduodenoscopy
SAVAMC	Southern Arizona Veterans Administration Medical Center
UNC	University of North Carolina
LGD	low grade dysplasia
HGD	high grade dysplasia
GERD-HRQL	Gastroesophageal Reflux Disease-Health-Related Quality-Of-Life scale
SF-36	Short form 36
CI	confidence interval

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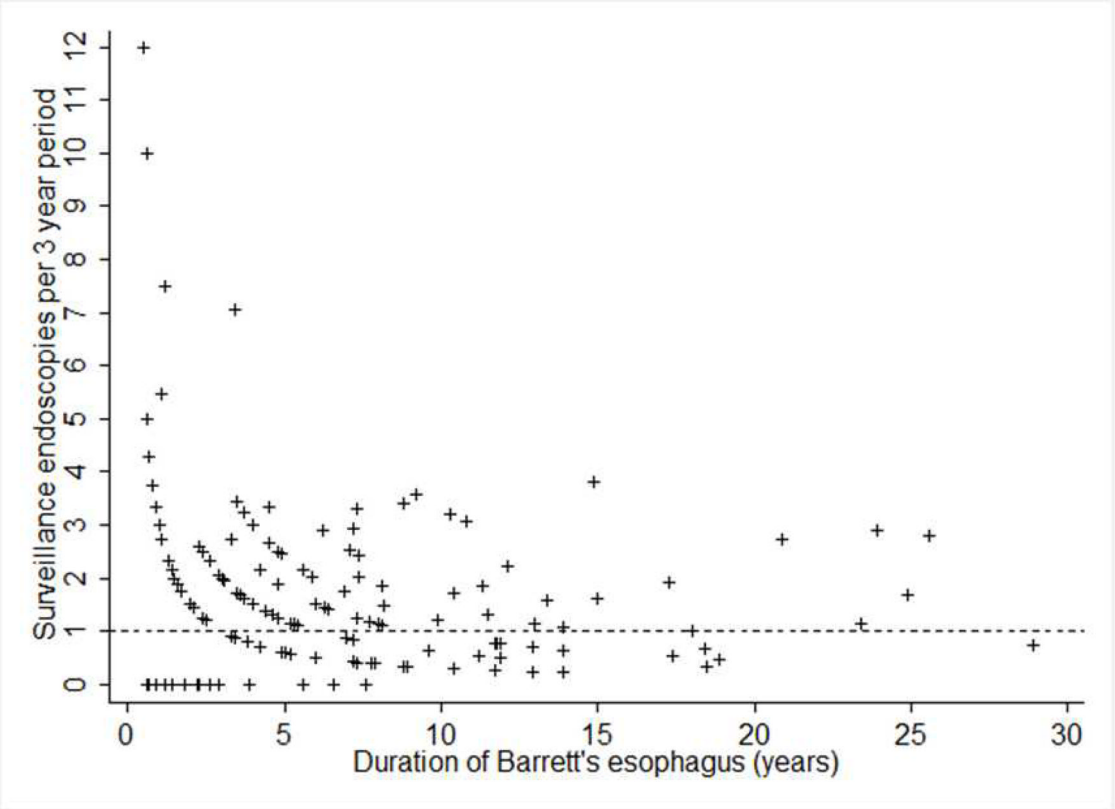

Figure 1.

Scatter plot of rate of endoscopy per 3 year period by duration of Barrett's esophagus, including all participants on whom endoscopy data and Barrett's duration data were available who had BE for more than 6 months (n=156), and discounting a single confirmatory endoscopy after initial BE diagnosis. Dotted line represents the recommended surveillance interval of the AGA, ACG and ASGE of 1 endoscopy every 3 years.[8, 9, 13]

Table 1

Characteristics of study participants with Barrett's esophagus (n=235)

Characteristic	n (%)
Sex	
Female	54 (22.9)
Male	180 (76.3)
Age	
<50 years	35 (15.0)
50–59 years	56 (23.9)
60–69 years	76 (32.5)
70–80 years	67 (28.6)
Race	
Black	5 (2.1)
White	221 (94.0)
Other	9 (3.8)
Site	
UNC	81 (34.5)
SAVAMC	75 (31.9)
Mayo	79 (33.6)
Education	
< High school graduate	12 (5.2)
High school graduate	46 (19.9)
Some college	75 (32.5)
≥College graduate	98 (42.4)
Annual household income	
<$25,000/year	26 (17.0)
$25,000–50,000/year	52 (34.0)
$50,000–100,000/year	52 (34.0)
>$100,000/year	23 (15.0)
Employment*	
Employed	109 (47.0)
Retired	131 (55.7)
Family history	
Barrett's	23 (10.4)
Esophageal cancer	13 (5.5)
Insurance†	
No insurance	7 (3.0)
Medicaid	2 (0.9)
Private	114 (48.5)
Medicare	54 (23.0)
VA	56 (23.8)
Years with Barrett's Esophagus	

Characteristic	n (%)
<1 year	31 (14.9)
1–4 years	79 (38.0)
5–9 years	48 (23.1)
≥10 years	50 (24.0)

* percentages for employment don't add to 100 due to overlap in categories (e.g. part-time employment following formal retirement)

† When multiple insurance types listed, hierarchical assignment was private→VA→Medicare→Medicaid→no insurance

Table 2

Utilization of endoscopic surveillance in patients with Barrett's esophagus, stratified by study site.

Variable	Overall n=235	Mayo n=79	SAVAMC n=75	UNC n=81
Years with BE (mean ± SD)	6.5 ± 5.9	5.2 ± 5.4	9.3 ± 6.2	5.2 ± 5.2
Endoscopy after BE diagnosis				
Yes (n (%))	211 (92.1)	68 (87.2)	69 (94.5)	74 (94.9)
No (n (%))	18 (7.9)	10 (12.8)	4 (5.5)	4 (5.1)
Total surveillance endoscopies (mean ± SD)	4.0 ± 4.0	3.1 ± 2.8	5.3 ± 5.1	3.8 ± 3.7
Months per endoscopy (mean ± SD)	20.2 ± 16.8	20.9 ± 18.6	25.4 ± 14.2	14.3 ± 15.5
Surveillance endoscopies per 2 year period† (mean ± SD)	1.8 ± 1.7	1.5 ± 1.0	1.1 ± 0.7	2.8 ± 2.5
Surveillance endoscopies per 3 year period† (mean ± SD)	2.7 ± 2.6	2.2 ± 1.5	1.7 ± 1.0	4.2 ± 3.7
>1 endoscopic surveillance per 2 year period†‡ (n (%))	70 (44.9)	20 (37.7)	16 (29.6)	34 (69.4)
>1 endoscopic surveillance per 3 year period†‡ (n (%))	102 (65.4)	30 (56.6)	31 (57.4)	41 (83.7)

† Patients with BE<6 months were excluded from these analyses.

‡ Discounting a single confirmatory endoscopy following BE diagnosis

Mayo: Mayo Clinic, Rochester, MN; SAVAMC: Southern Arizona VA medical Center, Tucson AZ; UNC: University of North Carolina Hospitals, Chapel Hill, NC

BE=Barrett's esophagus

SD=standard deviation

Table 3

Bivariate analysis comparing those with overutilization of surveillance endoscopy to those without overutilization.*

Variables	≤1 endoscopy per 3 years n = 54 n (%) or mean ± SD	>1 endoscopy per 3 years n = 102 n (%) or mean ± SD	p†
Sex			0.6
Female	10 (18.5)	22 (21.8)	
Male	44 (81.5)	79 (78.2)	
Age	62.1 ± 11.5	61.1 ± 11.5	0.6
Race			0.5
Black	0 (0.0)	2 (2.0)	
White	53 (98.2)	95 (93.1)	
Other	1 (1.8)	5 (4.9)	
Site			0.005
UNC	8 (14.8)	41 (40.2)	
SAVAMC	23 (42.6)	31 (30.4)	
Mayo	23 (42.6)	30 (29.4)	
Education			0.3
< High school graduate	0 (0.0)	5 (5.0)	
High school graduate	12 (22.6)	16 (15.8)	
Some college	20 (37.7)	33 (32.7)	
≥College graduate	21 (39.6)	47 (46.5)	
Annual household income			0.6
<$25,000/year	8 (17.8)	6 (10.0)	
$25,000–50,000/year	15 (33.3)	24 (40.0)	
$50,000–100,000/year	16 (35.6)	19 (31.7)	
>$100,000/year	6 (13.3)	11 (18.3)	
Insurance‡			0.04
No insurance	3 (5.6)	2 (2.0)	
Medicaid	1 (1.9)	0 (0.0)	
Private	18 (33.3)	54 (53.5)	
Medicare	12 (22.2)	22 (21.8)	
VA	20 (37.0)	23 (22.8)	
Family history of Barrett's esophagus	7 (13.2)	10 (10.3)	0.6
Family history of esophageal cancer	2 (3.7)	7 (6.9)	0.7
Years with Barrett's Esophagus	7.7 ± 6.0	6.1 ± 5.5	0.1
GERD HRQL	9.1 ± 8.9	7.8 ± 7.8	0.3

Variables	≤1 endoscopy per 3 years n = 54 n (%) or mean ± SD	>1 endoscopy per 3 years n = 102 n (%) or mean ± SD	p†
SF-36			
Physical component summary	44.8 ± 11.1	47.0 ± 10.2	0.2
Mental component summary	49.8 ± 11.4	50.9 ± 11.6	0.6
Heartburn severity	2.0 ± 1.2	1.8 ± 1.1	0.1
Worry of BE	2.2 ± 1.0	2.1 ± 1.1	0.4
Risk perception§			0.5
Overestimator	23 (43.4)	37 (38.1)	
Under/true estimator	30 (56.6)	60 (61.9)	
Physician visits/year	1.5 ± 1.7	1.2 ± 0.8	0.1
Dentist visits/year	1.3 ± 0.8	1.3 ± 0.7	0.9
Numeracy score**	87.0% ± 16.5%	84.0% ± 19.9%	0.4
Any use of internet for BE information	28 (51.9)	67 (67.0)	0.07

*Table includes data on the subset of subjects who had BE for ≥ 6 months, were able to ascertain their date of diagnosis, and could recall their endoscopy history (n=156). Overutilization defined as >1 endoscopy per 3 years, discounting a single confirmatory EGD.

†p values obtained via χ^2 tests or Fisher's exact tests for categorical variables, and Student's t-tests for continuous variables.

‡When multiple insurance types listed, hierarchical assignment was private→VA→Medicare→Medicaid→no insurance

§Measured with validated risk perception tool. Overestimators defined as those who estimated their 1 year risk of BE of >1%.

**Numeracy scores reflect ability of participants to answer 8 simple math questions as part of a validated numeracy measurement tool [22]. The highest score on this measure is 100%.

GERD HRQL: Gastroesophageal Reflux Disease Health-Related Quality of Life Questionnaire, a measure of disease-targeted quality of life; SF-36: Medical Outcomes Study Short Form-36, a measure of generic quality of life; BE: Barrett's esophagus. UNC: University of North Carolina; SAVAMC: Southern Arizona Veterans Administration Medical Center

Table 4

Multivariate analysis of factors related to overutilization of endoscopy*

Factor	Odds Ratio (95% CI)
Insurance status†	
Private	1.00 (referent)
Medicare	0.65 (0.25, 1.66)
VA	0.48 (0.20, 1.13)
No insurance/Medicaid	0.25 (0.04, 1.61)
Years with Barrett's esophagus‡	0.97 (0.91, 1.03)
Heartburn severity§	0.91 (0.66, 1.24)
Physician visits per year	0.89 (0.66, 1.20)
Use of internet for BE information	1.49 (0.71, 3.12)

*Overutilization defined as >1 endoscopy per 3 year period, discounting a 1st confirmatory endoscopy, and excluding patients with BE<6 months

†When multiple insurance types listed, hierarchical assignment was private→VA→Medicare→Medicaid→no insurance. Private insurance was used as the referent category, as this was the largest group, and no insurance/Medicaid strata were collapsed. Since insurance status and study site were collinear, both variables were not included in modeling.

‡OR represents change in odds per 1 year increase in duration of BE

§Heartburn severity measured by 5 point Likert scale where 0=no heartburn and 5=really bad heartburn

BE: Barrett's esophagus

Odds ratios obtained via multivariate logistic regression modeling