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Clinical variation in surveillance and management of Barrett's esophagus

A cross-sectional study of gastroenterologists and gastrointestinal surgeons

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Abstract

Appropriate surveillance and treatment of Barrett's esophagus (BE) is vital to prevent disease progression and decrease esophageal adenocarcinoma (EAC)-related mortality. We sought to determine the variation in BE care and identify improvement opportunities. 275 physicians (113 general gastroenterologists, 128 interventional gastroenterologists, 34 gastrointestinal surgeons) cared for 3 simulated patients, one each from 3 BE clinical scenarios: non-dysplastic BE (NDBE), BE indefinite for dysplasia (IND), and BE with low grade dysplasia (LGD), and care scores were measured against societal guidelines. Overall quality-of-care scores ranged from 17% to 85% with mean of 47.9% ± 11.8% for NDBE, 50.8% ± 11.7% for IND, and 52.7% ± 12.2% for LGD. Participants appropriately determined risk of progression 20.3% of the time: 14.4% for NDBE cases, 19.9% for LGD cases, and 26.8% for IND cases ($P = .001$). Treatment and follow-up care scores averaged 12.9% ± 17.5% overall. For the LGD cases, guideline-recommended twice-daily PPI treatment was ordered only 24.7% of the time. Guideline-based follow-up endoscopic surveillance was done in only 27.7% of NDBE cases and 32.7% of IND cases. For the LGD cases, 45.4% ordered endoscopic eradication therapy while 25.1% chose annual endoscopic surveillance. Finally, participants provided counseling on lifestyle modifications in just 20% of cases. Overall care of patients diagnosed with BE varied widely and showed room for improvement. Specific opportunities for improvement were adherence to guideline recommended surveillance intervals, patient counseling, and treatment selection for LGD. Physicians would potentially benefit from additional BE education, endoscopic advances, and better methods for risk stratification.

Abbreviations: ACG = American College of Gastroenterology, AGA = American Gastroenterological Association, ASGE = American Society for Gastrointestinal Endoscopy, BE = Barrett's esophagus, CPV = Clinical Performance and Value, EAC = esophageal adenocarcinoma, EET = endoscopic eradication therapy, HGD = high-grade dysplasia, IND = indefinite for dysplasia, LGD = low-grade dysplasia, NDBE = nondysplastic Barrett's esophagus, NSAID = nonsteroidal anti-inflammatory agents, PPI = proton pump inhibitor, QUBE = QURE Barrett's esophagus study.

Keywords: Barrett's esophagus, esophageal adenocarcinoma, gastroenterologists, gastroesophageal reflux disease, gastrointestinal surgeons, high-grade dysplasia, low-grade dysplasia, nondysplastic Barrett's esophagus

1. Introduction

Barrett's esophagus (BE) is a premalignant condition and the only known precursor lesion for esophageal adenocarcinoma (EAC). EAC is now the 10th most fatal cancer in the world with a dramatically rising incidence in Western countries.[1–3] With a 5-year survival rate of 20%, EAC prognosis strongly correlates with the cancer stage at the time of diagnosis.[1–4] In patients

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with EAC, as many as 64% had BE at the time of their cancer diagnosis, and in others, the cancer may have overgrown small BE segments.[5,6]

Progression of BE to invasive EAC likely occurs in a stepwise pattern starting with nondysplastic BE (NDBE) to low-grade dysplasia (LGD) to high-grade dysplasia (HGD), and finally, to invasive carcinoma.[1] When pathologists are unable to definitively diagnose NDBE, LGD, or HGD, they will diagnose the patient with BE indefinite for dysplasia (IND). The annual rate of progression to HGD/EAC is 0.63% for NDBE patients.[7] This nearly triples to 1.7% among patients with LGD.[8] Patients with IND have a similar annual rate of progression to HGD/EAC at 1.5%.[9] Notably, the rate of EAC rises to 19% among those with HGD.[10,11] The American College of Gastroenterology (ACG) and American Gastroenterological Association (AGA) guidelines outlined the following specific risk factors for neoplastic progression: patients with advancing age, increasing length of BE, hiatal hernia, obesity, tobacco use, high degrees of dysplasia, and nonuse of nonsteroidal anti-inflammatory agents (NSAIDs), proton pump inhibitor (PPI), or statins, however, progression is variable and not predictable.[11]

Current strategies to improve EAC survival center on earlier detection at a potentially curable stage. Endoscopic surveillance is associated with earlier stage at diagnosis of EAC in patients with BE.[12] The ACG, AGA, and the American Society for Gastrointestinal Endoscopy (ASGE) have promulgated clinical practice guidelines and quality indicators for surveillance endoscopy and endoscopic eradication therapy (EET) of BE.[4,11,13] Despite these efforts to standardize care for patients with BE, various retrospective studies show that there is suboptimal adherence to recommended endoscopic surveillance intervals at about 50% compliance rate.[14–20] Similarly, physicians also fail to adhere to BE treatment guidelines. Failure to follow these guidelines leads to a significant reduction in the dysplasia detection rate and necessary treatment, as well as overuse of endoscopic surveillance and EET in patients who are at low risk for progression to HGD/EAC.[14–20]

We conducted the QURE Barrett's Esophagus (QUBE) study to prospectively evaluate guideline adherence to surveillance and management of BE. To eliminate patient-level variation and generate high quality comparative data, the QUBE study used simulated patients. With participants taking care of the same patients, we evaluated clinical practice variation among gastroenterologists and gastrointestinal (GI) surgeons caring for typical BE patients. We measured the ability of these providers to determine appropriate surveillance intervals and prescribe appropriate treatment and therapies to a spectrum of BE patients.

2. Methods

From August 2021 to December 2021, we conducted a prospective evaluation on the work-up, endoscopic surveillance, and treatment of BE among gastroenterologists and GI surgeons practicing in the US. Using Clinical Performance and Value (CPV®) vignettes, the QUBE study measured and analyzed data on clinical practice variation by having all study participants care for the same set of simulated patients.

2.1. Ethics

The QUBE study was conducted in accordance with ethical standards, approved by Advarra Institutional Review Board, Columbia, MD, and listed in clinicaltrials.gov (NCT05200325). We obtained informed consent from all participants through an online voluntary consent process. All data were kept confidential.

2.2. Physician selection

Via an email campaign, we recruited adult gastroenterologists and GI surgeons who manage patients with BE from a nationally representative list of over 23,000 physicians. The list was generated from multiple sources, including physician contact files, workforce databases, server lists, and rosters from relevant conferences, hospitals, medical associations, and professional organizations.

We gave the potential participants an 8-item questionnaire to determine their eligibility, which was based on the following criteria at the time of the study: board certification in gastroenterology or surgery for at least 2 years, performance, on average, of at least 20 hours per week of clinical and patient care duties over the last 6 months, reports of routine evaluation of patients with upper GI disorders, practice in the United States, English speaking, access to the internet, and voluntarily consent to participate in the study.

Of the 423 specialist physicians who completed the self-administered questionnaire, 286 were eligible, based on the criteria listed above, and agreed to participate in the study. Exclusion criteria included physicians who were pediatric gastroenterologists, were not board-certified, averaged less than 20 clinic hours per week, did not routinely see patients with upper GI symptoms, and did not consent to be part of the study. Eleven eligible physicians did not complete the study and were not included in the final sample: of these eleven physicians, 3 participants retracted their consent to participate while the other 8 physicians did not complete their online cases. The final study population who completed the study consisted of 275 physician specialists divided between 113 general gastroenterologists, 128 interventional gastroenterologists, and 34 GI surgeons, as self-classified.

2.3. Data sources

2.3..1. Physician survey. Once enrolled, we gave the study participants a follow-on 10-item questionnaire asking them to detail their practice and professional background. This survey included questions on employment status, location of practice, inpatient versus outpatient care, practice type, and incentives from clinical practice, among others.

2.3..2. Clinical performance and value (CPV®) vignettes. To collect data on clinical practice variation, we used CPV® vignettes. The CPV® vignette is an online patient simulation tool validated to reflect actual care when compared to standardized patients and chart abstraction.[21] Now widely used to measure clinical care,[22,23] the vignettes consist of open-ended questions that are divided into 4 domains of care: collecting a history, performing a physical exam, ordering diagnostic work-up, and selecting a diagnosis and formulating a treatment and follow-up plan (diagnosis + treatment). CPVs have been used in many studies to evaluate and compare the clinical practice of physicians in a comprehensive range of clinical conditions and settings.[24–27] In a CPV, physicians are asked to care for the simulated patients just as they would in an actual patient visit.

Participants were scored on their care using explicit pre-determined criteria, based on the current clinical guidelines from the ACG, AGA, and ASGE for diagnosis and management of BE. Trained expert physicians working independently and blinded to participant identities, evaluated the provided clinical care. A quality-of-care score, ranging from 0% to 100%, was generated for each domain of care: taking a history, performing a physical exam, ordering a diagnostic work-up, establishing the diagnosis, and forming a management plan. In each domain, 100% indicated perfect compliance with societal guidelines while 0% indicated complete noncompliance. The research team then calculated a combined overall quality-of-care score for each case by summing the total number of correct items performed for the entire case and dividing by the total number of correct items possible.

2.3..3. Barrett's esophagus vignettes. We constructed 9 CPV vignettes grouped into 3 patient case types: NDBE, BE with

IND, and BE with LGD. For each case type, 2 cases consist of a BE patient with a high-risk clinical profile and one case of a BE patient with a low-risk clinical profile. Clinical profiles were based on the previously outlined risk factors for neoplastic progression by the ACG and AGA. Each physician participant was asked to care for 3 randomized simulated CPV patients, one from each case type. The CPV cases resembled a typical patient with BE. A more detailed description of the cases can be found in Table 1.

2.4. Analysis

We aimed to determine if current practices in the work-up, diagnosis, and follow-up care of the 9 patients diagnosed with BE were consistent with selected elements from published guidelines from the ACG and ASGE, which are listed below in Table 2.[4,11] AGA guidelines were not included since the AGA has not released a new complete guideline on BE since 2011, and practice updates released since then result in similar overall recommendations compared to ACG and ASGE.[11,28] Specifically, the primary outcomes measured were the overall and diagnosis + treatment score, as well as obtaining primary diagnosis; the assignment of high risk or low risk of progression to HGD/EAC; the frequency at which study participants perform a surveillance endoscopy based on the patient's clinical profile and BE case type; and how often the respondents recommended EET or surgical management of BE and its associated conditions. Secondary outcomes include: determination of possible factors that affect adherence to guidelines (e.g., area of specialization, type of practice, years in practice, age, etc.); measurement of clinical variation in terms of patient counseling, education on lifestyle modifications and use of PPI for chemoprevention; and measuring any differences in care between general and interventionalist gastroenterologists and GI surgeons. Summary statistics were calculated for all variables. Numerical variables were summarized through mean and standard deviation, or median and interquartile range. Chi-squared tests and logistic regression modeling were used for analyses involving binary outcome variables (e.g., diagnosing BE), and *t*-tests and linear regression modeling were used for the analysis of continuous outcomes (e.g., diagnosis treatment scores). All analyses were performed using Stata 15.1.

3. Results

3.1. Physician characteristics

The 275 board-certified gastroenterologists and GI surgeons who met the eligibility requirements completed 3 CPV patient cases (Table 3). The majority of the sample were gastroenterologists (85.7%). In line with national averages for the United States, males made up 85% of participants, and the mean (+ SD) age was 51.2 + 12.0 years old. The physician participants had, on average, 22.4 + 12.4 years of practice experience and provided an average of 47.6 hours of patient care per week. Almost 4 in 5 (79.3%) study participants were employed by their practice and most worked in an urban or suburban setting (92.8%). By practice type, nearly half (48.5%) worked in private practice, while most of the remaining (37.9%) worked in an academic setting. Just over a third (37.1%) received a quality bonus, defined as an additional bonus payment for achieving high scores on a variety of quality metrics. The average payer mix for these specialists was 47.4% commercial, 43.7% Medicare/Medicaid, 3.6% self-pay, and 5.3% other forms of payment.

3.2. Variability of physician clinical decisions

The overall quality-of-care scores across all 825 cases (with each case type randomly assigned) ranged widely from 17% to 85% per vignette (Fig. 1) with an average score of 50.5% ± 12.0%. This variation was found for each case type where the mean scores were 47.9% ± 11.8% for NDBE cases, 50.8% ± 11.7% for the IND cases, and 52.7% ± 12.2% for the LGD cases ($P < .001$).

3.3. Domains of care.

Across the domains of care, we saw a steady decline in guideline-based scores as participants worked through their

Table 1

CPV simulated case type descriptions.

Case types	Variant A: higher risk clinical Profile	Variant B: lower risk clinical Profile	Variant C: higher risk clinical Profile
Non-dysplastic BE	67-year-old male patient, Caucasian Short segment NDBE (C2M2) diagnosed 3 years ago, on PPI once daily Overweight, current smoker, with family history of EAC in the second-degree relative, on statin Surveillance EGD: nondysplastic BE (C2M2); Hiatal hernia	48-year-old female patient, African-American Short segment BE (C3M3), confirmed IND a year ago, on PPI twice daily Obese, previous smoker, with diabetes, HTN, on statin Surveillance EGD: nondysplastic BE(C3M3); Hiatal hernia	70-year-old male patient, Caucasian Long segment BE (C4M6), confirmed LGD a year ago, on PPI twice daily Obese, previous smoker, with COPD, dyslipidemia, on statin Surveillance EGD: nondysplastic BE (C4M6); Hiatal hernia
Indefinite dysplasia	66-year-old male patient, Caucasian Long segment BE (C5M7), IND diagnosed 3 mo ago, on twice daily PPI Obese, current smoker, persistent GI symptoms, more severe in the last 2 weeks, with dyslipidemia, on statin Surveillance EGD: BE, IND (C5M7); Hiatal hernia	60-year-old female patient, African-American Short segment BE (C2M2), initially NDBE 5 years ago; IND, on surveillance 6 mo ago, on twice daily PPI Overweight, nonsmoker, with HTN, on statin Surveillance EGD: BE, IND (C2M2); Hiatal hernia	66-year-old male patient, Caucasian, Short segment BE (C1M2), NDBE, diagnosed 8 years ago, on once daily PPI Obese, nonsmoker, with OA Surveillance EGD: BE, IND (C1M2); Hiatal hernia
Low grade dysplasia	65-year-old male patient, Caucasian, with recurrent reflux symptoms for the past 3 months, on once daily PPI Obese, nonsmoker, with anxiety disorder Screening EGD: Long segment BE (C6M10), confirmed LGD; Hiatal hernia	57-year-old male patient, African-American Diagnosed with GERD 6 years ago, refused EGD; occasional symptoms; older cousin recently diagnosed with BE and underwent endoscopic treatment Overweight, nonsmoker, with adult-onset bronchial asthma Screening EGD: Short segment BE (C2M2), confirmed LGD	70-year-old male patient, Caucasian Long segment BE (C5M8), confirmed LGD, diagnosed a year ago. Opted for annual surveillance, on twice daily PPI Overweight, current smoker, obese, with diabetes, on statin Surveillance EGD: Confirmed LGD (C5M8); Hiatal hernia

Table 2

ACG and ASGE Guidelines* for diagnosing and treating patients with BE.

Strategy	NDBE	IND	LGD
Instrument	ACG: High-definition/high resolution white light endoscopy (WLE) ASGE: Chromoendoscopy, including virtual Chromendoscopy	ACG: High-definition/high resolution WLE ASGE: Chromoendoscopy, including virtual chromendoscopy	ACG: High-definition/high resolution WLE ASGE: Chromoendoscopy, including virtual chromendoscopy
Surveillance	Adequate counseling regarding risks and benefits of surveillance EGD at intervals of 3 to 5 yr	Adequate counseling regarding risks and benefits of surveillance Repeat EGD after optimization of acid suppressive medications for 3–6 mo. If IND confirmed on repeat examination, surveillance interval of 12 mo	Adequate counseling regarding risks and benefits of surveillance Consider EET, and endoscopic surveillance (EGD every 12 mo) as an acceptable alternative
Medication	Recommended PPI treatment (dosage depends on proper symptom control)	Twice daily dosing of PPI for 3–6 mo prior to confirmation exam	Twice daily dosing of PPI
BE treatment	EET should not be routinely applied;	EET should not be routinely applied;	EET: preferred modality for those without life-limiting comorbidity; endoscopic surveillance acceptable alternative
Antireflux surgery	Should not be pursued as an antineoplastic measure; Consider in those with incomplete control of reflux on optimized medical therapy	Should not be pursued as an antineoplastic measure; Consider in those with incomplete control of reflux on optimized medical therapy	Should not be pursued as an antineoplastic measure; Consider in those with incomplete control of reflux on optimized medical therapy

ACG = American College of Gastroenterology, AGA = American Gastroenterological Association, ASGE = American Society for Gastrointestinal Endoscopy, BE = Barrett's esophagus, EET = endoscopic eradication therapy, NDBE = nondysplastic Barrett's esophagus, IND = indefinite for dysplasia, LGD = low-grade dysplasia.
*AGA was not included in this table as their guidelines were last updated in 2011.

Table 3

Baseline provider characteristics.

	All providers	General GI	Interv. GI	Surgeon
N	275	113	128	34
Gender				
Male	84.1%	76.1%	87.5%	97.1%
Female	14.8%	22.1%	11.7%	2.9%
Prefer not to say/other	1.1%	1.8%	0.8%	0.0%
Age	51.1 + 12.1	52.1 ± 12.6	50.8 ± 11.9	48.7 ± 11.2
Specialty				
Gastroenterology	86.3%	100%	100%	0%
Surgery	13.7%	0%	0%	100%
Years of experience	22.3 + 12.5	24.2 ± 13.6	21.9 ± 11.9	18.1 ± 10.5
Hours/week of patient care	47.4 + 18.8	43.7 ± 15.0	49.2 ± 22.6	51.5 ± 12.6
Time in outpatient setting, %	74.1%+21.8%	80.7%±17.9%	75.0%±19.4%	50.9%±23.5%
Region				
Northeast	27.4%	23.9%	32.0%	17.7%
South	31.4%	30.1%	35.2%	23.5%
Midwest	18.1%	20.4%	17.2%	14.7%
West	23.1%	25.7%	15.6%	44.2%
Practice type				
Academic	36.7%	33.0%	40.9%	35.3%
Community hospital	13.8%	11.6%	11.8%	29.4%
Private, multispecialty	14.2%	15.2%	12.6%	17.7%
Private, single specialty	25.1%	25.9%	29.1%	2.9%
Private, solo	10.2%	14.3%	5.5%	14.7%
Practice setting				
Urban	50.2%	49.6%	55.5%	38.2%
Suburban	42.6%	43.4%	36.7%	55.9%
Rural	7.2%	7.1%	7.8%	5.9%
Employed by practice	79.4%	84.1%	78.1%	73.5%
Participate in CMS				
Yes	33.6%	36.3%	28.1%	17.7%
No	30.3%	37.4%	40.6%	29.4%
Do not know	36.1%	36.3%	31.3%	52.9%
Receive quality bonus	38.6%	31.9%	41.4%	47.1%

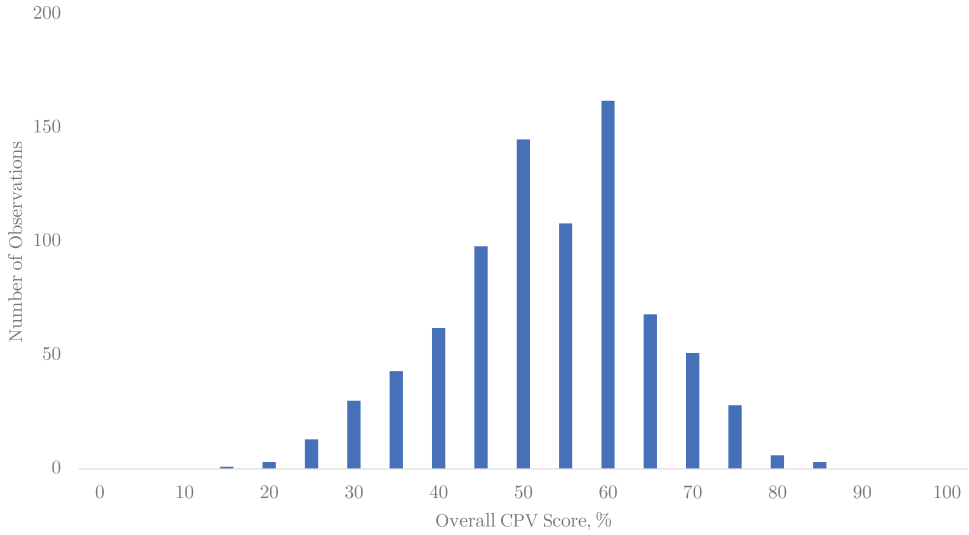

Figure 1. Histogram of CPV scores.

cases, with providers scoring 68.3%+13.7% in taking a history, 63.1%+23.4% in performing a physical exam, and 50.5%+45.4% in ordering diagnostic workup. Comparatively, scores in the diagnosis + treatment domain were notably low, with an average score of 20.9%+14.9% across all cases. Comparable to the overall score, there was a significant difference across the case types ($P < .001$): lowest for NDBE cases (17.4%+14.2%) rising slightly for the IND cases (20.3%+12.3%), and highest for the LGD cases (25.0%+16.8%).

In regression analysis, after controlling for provider and practice characteristics, case type, and getting the correct diagnosis, better guideline-based management and follow-up care was associated with younger providers (age < 45), who scored 2.9% higher ($P = .026$) (Table 4).

3.4. Diagnostic accuracy

The overall diagnostic domain score across all 3 case types, measures how well participants either make a new diagnosis of BE or determine the patient's risk of progression to either HGD or EAC.

The new diagnosis of BE (2 of 9 cases; both with LGD), was done correctly 73.6% of the time. Of those who missed the initial BE diagnosis, they incorrectly diagnosed the patient with GERD 24.7% of the time, and 1.7% of the time they thought the diagnosis was something else (esophageal cancer, peptic ulcer disease, or IBS).

When we looked at classifying the patient's risk of progression to HGD or EAC according to the patient's given risk factors (e.g., age, obesity, tobacco, etc.)[9] and endoscopic findings (degree of dysplasia and BE length), only 20.3% correctly recognized all relevant risk factors to make the appropriate risk classification (whether high risk or low risk for progression to HGD/EAC). Providers were least likely to correctly specify the risk of progression to HGD/EAC in the NDBE cases (14.4%), then in LGD cases (19.9%), and, finally, in the IND cases (26.8%) ($P = .001$).

When a physician ordered a guideline recommended high-definition white light upper GI endoscopy (either with or without chromoendoscopy), multivariate regression analysis showed they were more than 28x (O.R. 28.9, 95% C.I. 8.6 to 96.4; without chromoendoscopy) and 47 × (47.4, 95% C.I. 14.0 to 160.0; with chromoendoscopy) more likely to correctly diagnose the new BE cases.

3.5. Accuracy of initial treatment and follow-on care

We looked at guideline-based treatment, either follow-on repeat surveillance endoscopy or EET for the 3 different case types. For the NDBE cases, the guidelines recommend surveillance endoscopy at 3 to 5 years. We found; however, the guideline-recommended repeat surveillance endoscopy was ordered in just 27.7% of the cases, compared to 8.3% who opted to repeat surveillance endoscopy within 6 months, 14% of participants who opted for one year, and 14% who ordered surveillance endoscopy but did not specify a frequency. Another 9% ordered EET instead of repeat surveillance endoscopy for the NDBE cases, and the remainder ordered other tests (manometry, imaging studies, etc.) (Table 5). For the IND cases, 32.7% ordered the guideline recommended repeat surveillance endoscopy at 3 to 6 months, compared to 1.5% who opted for surveillance endoscopy within a month, 16.9% who opted for surveillance endoscopy at one year, 6.3% who opted for surveillance endoscopy at 3-5 years, and 16.5% who ordered repeat surveillance endoscopy but did not specify a timeframe. Like NDBE, 11% went directly to EET. By comparison, in the LGD cases, 43.5% correctly ordered the guideline recommended EET and 22.8% ordered the appropriate alternative repeat surveillance endoscopy at one year, while 1.1% ordered immediate surveillance endoscopy, 7.0% ordered surveillance endoscopy in 3 to 6 months, 1.8% ordered surveillance endoscopy at 3 to 5 years, with 11.1% ordered repeat surveillance endoscopy without a specific schedule (Table 5).

For the LGD cases, where EET is the preferred treatment and repeat surveillance endoscopy within one year is an acceptable alternative, gastroenterologists ordered one of these LGD

Table 4

Multivariate regression model for treatment subdomain.

	Coef.	*P* value
Male	−1.6	.329
Age < 45	2.9	.026
Gastroenterologist	1.2	.496
South	1.7	.196
Urban	1.9	.104
Solo practice	−2.1	.302
CPV area		
IND	−0.1	.929
LGD	7.2	<.001
Correct histology	4.1	<.001
Correct severity	0.1	.930
_cons	2.1	.455

CPV = clinical performance and value, IND = indefinite for dysplasia, LGD = low-grade dysplasia.

Table 5

Frequency of physician orders for repeat surveillance endoscopy, endoscopic eradication, or other test by case type.

	Repeat surveillance endoscopy schedule						
Case type	**<1 mo (%)**	**3–6 mo (%)**	**1 yr (%)**	**3–5 yr (%)**	**Unspecified (%)**	**Endoscopic eradication therapy (%)**	**Other tests* (%)**
NDBE	0.0	8.3	14.0	**27.7**	14.0	9.0	27.0
IND	1.5	**32.7**	16.9	6.3	16.5	11.0	15.1
LGD	1.1	7	**22.8**	1.8	11.1	**43.5**	12.7

*Other tests include manometry, imaging studies, etc.

management approaches 61.2% of the time compared to the surgeons who ordered them 79.4% of the time. Logistic regression revealed that those who correctly identified the risk of progression to HGD/EAC in the LGD cases were more than 4 times as likely (OR 4.4, 95% C.I. 2.0–9.8) to order EET or annual surveillance endoscopy for LGD patients. GI surgeons were more likely than gastroenterologists to order this preferred treatment (OR 2.7) but it was not significant (95% C.I. 1.0–7.5).

We investigated the pharmacologic treatment—use of PPIs for LGD patients—among the participants. We focused specifically on LGD patients because there were no binary recommendations for PPI dosing and long-term use in NDBE and IND patients for chemoprevention. In the LGD cases, where the standard of practice details PPI should be increased to twice daily, providers did so 24.7% of the time, with little difference whether they were starting a new regimen (20.2%), continuing an existing one (25.5%), or increasing the PPI dose (28.3%). Conversely, the other 75.3% did not indicate they would prescribe PPI at twice daily.

We also looked at non-pharmacological treatment guideline recommendations. Participants provided counseling on lifestyle modifications (smoking cessation, weight loss, dietary/nutrition changes) in just 20% of cases (19.9%). Providers were most likely to advise the patient to quit smoking (25.7%, in the 3 of 9 cases where the patient smoked), followed by recommending dietary/nutrition changes (14.2%, in 5 of the 9 cases where the patient was experiencing symptoms of epigastric pain, bloating, or reflux), and recommended weight loss (9.2%, in 7 of the 9 cases where the patient was obese or overweight). In previously undiagnosed BE cases (2 cases), explained the implications of their patients' new diagnoses 9% of the time, with the rest not indicating they would offer patient counseling.

Then, we looked at the procedural treatments, especially anti-reflux surgery/fundoplication which is considered unnecessary by guidelines. In 6 of the 9 cases antireflux surgery/fundoplication is considered unnecessary by guidelines. Notwithstanding, providers unnecessarily ordered a fundoplication 10.3% of the time: 6.7% in the NDBE cases, rising to 8.1% for the IND cases, and 15.8% for the LGD cases. The GI surgeons were much more likely to order the fundoplication compared to the gastroenterologists (51.4% vs 4.1%, $P < .001$). Similarly, bariatric surgery, considered to be low-value in 8 of the 9 cases and appropriate in the other case, was offered in 1.5% of all cases, with 2.2% ordering this surgery for the NDBE cases, 1.8% for the IND cases, and 0.4% for the LGD cases. GI surgeons, again, were more likely to order this surgery than gastroenterologists (18.9% vs 2.3%, $P < .001$).

3.6. General versus interventional gastroenterologist versus GI surgeons

We compared the practice of the 113 general gastroenterologists, the 128 interventional gastroenterologists, and the 34 surgeons. Throughout the analysis we found no differences between general versus interventional gastroenterologists across a wide set of data: overall score, diagnosis + treatment score, ordering an endoscopy, assigning the risk of progression to HGD/EAC, ordering 3- to 5-year surveillance EGD in the NDBE cases, ordering 3- to 6-month surveillance in the IND cases, doing an EET, or ordering annual surveillance endoscopy ($P > .20$ for all) in the LGD cases. Conversely, we found differences between gastroenterologists and GI surgeons as detailed above.

4. Discussion

We conducted a prospective cross-sectional study to evaluate the care provided by gastroenterologists and GI surgeons among patients diagnosed with BE. The specific outcomes were the timing of repeat surveillance and the definitive treatment practices as compared to recommended care per the ACG/ASGE guidelines for 3 histopathological BE diagnoses.

Our prospective study confirmed our hypothesis, showing a significant degree of variation in clinical decisions among gastroenterologists and GI surgeons in managing established BE. Our study also showed that there is poor adherence to the ACG and ASGE guidelines recommended endoscopic surveillance schedule. In the majority of the simulated NDBE and IND vignettes, an incorrect follow-up schedule was recommended. These findings replicate previous studies demonstrating a large degree of variability in the selection of follow-up surveillance intervals.[14–20] Whether this represents a lack of knowledge on the part of clinicians, or the wish to select a shorter interval to "be careful" or "more thorough" is unclear from these data.

We found that physicians were able to care for patients with LGD significantly better than the average score (+9.2%) when compared to NDBE and IND case types. Notwithstanding only 43.5% correctly ordered the guideline recommended EET and 22.8% ordered appropriate alternative repeat surveillance endoscopy at one year. Those who correctly identified the risk of progression to HGD/EAC in the LGD cases were over 4 times likelier to order these appropriate management plans, indicating these physicians may have had a better overall understanding of the presentation and management of the disease. This finding also reflects a potential benefit in increasing risk stratification methods, especially for those physicians who were unable to qualitatively identify the patient's risk of progression to HGD/EAC.[31] Conversely, the NDBE cases had the lowest diagnostic and treatment scores perhaps because of the few interventions demonstrated by data to improve the already excellent prognosis of NDBE patients. While 90% or more of the BE surveillance population has NDBE, representing the majority of a gastroenterologist's typical BE caseload.[32] NDBE patients harbors many patients who require proactive management.

For pharmacologic treatment of LGD, participants adhered to the current guidelines by ordering PPI twice daily only 24.7% of the time. The low compliance to the guideline-recommended PPI dosing frequency may reflect unfamiliarity with guideline recommendations on PPI use or as part of the limitation of the tool (CPV) used in the study where participants give their answers in free text format without specific prompts about prescribing PPI.

Providing patient education was notably suboptimal in this study with providers initiating a patient-centered discussion on endoscopy findings and implications only 9% of the time

to those newly diagnosed with BE and recommending lifestyle modifications in just 20% of cases, even with known risk factors associated with development of neoplasia in BE include central obesity and tobacco usage.[9] Delivering more patient education is clearly an area for improvement, and may represent an opportunity for nurse counselors, nutritionists, and other partners to impact care in BE.

There were no significant differences in the care provided by gastroenterologists across all cases of BE, whether they were generalists or interventionalists. However, GI surgeons were 3 times more likely as gastroenterologists (367%, 95% C.I. 120%–1129%) to appropriately order EET or annual surveillance endoscopy for LGD patients, a finding also seen in an earlier study.[19] Surgeons, on the other hand, were also more likely to order unnecessary, as per the guidelines, fundoplication and bariatric surgery leading to avoidable health complications and higher costs.

Previous studies on physician adherence to guidelines in the management of BE, however, were retrospective analyses involving chart reviews and focused on surveillance or endoscopic techniques (i.e., adherence to Prague criteria and Seattle protocol) rather than on treatment adherence and overall care and did not look at the use of low-value surgical interventions for patients with BE.[16,18] This study adds to the previous studies that show poor adherence to guidelines and worrisome quality of care for patients with BE by evaluating clinical practice prospectively without a retrospective bias, collecting data for a full range of patients at risk for EAC, and assessing a wide range of practice variation in several points of care in BE management, including chemoprevention. Our results show that diagnosis and care for patients with BE needs improvement, whether with greater education on the guidelines, a new diagnostic test, or some other solution.

The limitations to our study include the smaller number of GI surgeons compared to gastroenterologists. By design, the study did not determine the quality of the endoscopic examination and/or EET performed. We also did not investigate the specific reasons participants did not adhere to the guidelines. Finally, we know that there are several challenges in managing BE that we did not investigate in this study around tissue sampling: BE does not affect all tissue in the esophagus, meaning that dysplasia can be missed by random sampling,[33] multiple pathologists are often needed to diagnose the level of dysplasia,[34] especially in LGD,[35] and the transition from low to high grade dysplasia or EAC is not always steadily progressive, with 26.6% of HGD/EAC cases being missed.[36] Had we included these other ambiguities, however, it would increase the variability we observed and thus our findings conservatively report on the challenge gastroenterologists face in diagnosing and treating BE.

5. Conclusion

Overall, these results show that adherence to guideline recommendations for treatment and follow-on management of BE is poor. The least severe form of the disease (NDBE) was the most troublesome for study participants. Improvement areas include adherence to surveillance intervals, patient counseling and education, and selection of appropriate care for patients with LGD. There is also significant heterogeneity on BE prognostication based on the clinical risk factors and endoscopic results.

To assist physicians in their care decisions, there could be improved educational efforts for physicians caring for BE patients. Development and utilization of newer technology such as artificial intelligence to improve BE and dysplasia detection, or biomarkers that assist in prognostication may refine current surveillance and treatment strategies for BE. Guidelines are helpful; however, this study highlights that they are not regularly followed. Additional objective data that helps physicians avoid overuse of frequent surveillance in NDBE patients and assign EET or more frequent surveillance for LGD patients will help further EAC prevention.

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