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Enhancing High Value Care in Gastroenterology Practice

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Abstract

The objective of this review is to identify common areas in gastroenterology practice where studies performed provide an opportunity for enhancing value or lowering costs. We provide examples of topics in gastroenterology where we could enhance value by either using less invasive testing, choosing a single best test, or by using patient symptoms to guide additional testing. The topics selected for review are selected in esophageal, pancreatic and colorectal cancer, functional gastrointestinal diseases (irritable bowel syndrome, bacterial overgrowth, constipation), immune-mediated gastrointestinal diseases, and pancreatico-biliary pathology, and we propose guidance to alter practice based on current evidence.

These studies support the need to review current practice and to continue performing research to further validate the proposed guidance in order to enhance value of care in gastroenterology and hepatology.

INTRODUCTION

In the United States, healthcare expenditures approached 18% of the gross domestic product in 2015.[1] To reduce this formidable expense, government, payors, and physicians must embrace care that offers not only high quality but value. Specifically, high value, cost conscious care refers to care that aims to assess the benefits, harms, and costs of interventions and, consequently, to provide care that adds value.[2] The burden of digestive diseases in the United States and associated physician visits, emergency department visits and hospitalizations are well documented.[3] For example, in 2011, more than one million people in the United States were living with colorectal cancer, and the leading GI causes of death were colorectal, pancreatic and hepatobiliary neoplasms.

The gastrointestinal field has not yet addressed, in a systematic manner, the options for high value, cost conscious care. Pursuing high value care may be simple, for example avoiding excess radiation through indiscriminate use of abdominal computerized tomography

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(CT).[4, 5] It may also be more complicated. For example, although biologic agents used for inflammatory bowel disease (IBD) are costly,[6] use of biologics with or without immunomodulator therapy is associated with decreased IBD-related healthcare utilization and expenses, including hospitalizations and surgery.[7,8] Toward this end, "Choosing Wisely Recommendations" from the American Gastroenterological Associations (AGA) are advocated in gastroenterology practice[9] (Table 1).

The American College of Physicians[10] has recommended five principles to guide test ordering:

1. Was the test performed previously?
2. Would the test result change care of the patient?
3. What are potential adverse consequences of a false positive result?
4. Are there potential dangers over the short term if the test is not performed?
5. What is the motive for performing the test, such as patient's request or reassurance?

A commonly used definition of value is utility/cost. It is difficult to discuss specific concepts around costs because of the wide variance in costs in different clinical settings and the gap between costs, charges and reimbursements. Nevertheless, in general, endoscopic and imaging procedures tend to be costly and, therefore, drew our attention to appraise their utility in greater detail, by appraising the level of evidence that they impact the diagnosis and management of commonly encountered gastroenterological disorders.

The objective of this review is to highlight ten areas of gastroenterology practice where current studies present opportunities for enhancing value or lowering costs by identifying features that predict increased yield on further testing or management strategies that enhance high value care. We highlight this process by providing examples of topics in gastroenterology where we could enhance value by either using less invasive testing or by using patient symptoms to guide additional testing. We selected examples of illnesses that either have high prevalence or are difficult to diagnose and thus lead to repeated, multiple or costly tests.

Our analysis of the literature, based whenever available on systematic reviews, has identified opportunities for choosing wisely, beyond the original five recommendations from AGA[9]. As the availability of well-powered studies and systematic reviews and meta-analyses is limited for many of the selected topics, the details of the studies (e.g. sample size, characteristics of the cohort examined) have been included to help guide the reader on the validity of the recommendation made in the article in the cited literature or our recommendation after appraising the studies. The questions are intentionally provocative and intended to initiate the debate on enhanced value care in the field; in many situations, the proposed guidance falls short of definitive recommendations for clinical practice until further proof is forthcoming.

In this review, we appraise the clinical utility and accuracy of tests in an attempt to provide guidance that could lead to high value patient care. The sensitivity and specificity of

diagnostic tests, as well as the tests' positive and negative predictive values are documented (based on the literature) with the goal of appraising the utility of the tests. However, since disease prevalence can impact the positive predictive value (PPV), low values of PPV and specificity may be acceptable as long as there is high sensitivity.

This selection is a first step; further analysis of other areas of gastroenterology, with the need to revise current practice, should lead to enhanced high value care. Further advances will require well conducted, large-sample studies in varied demographic groups, followed by large pragmatic clinical trials with cost calculations to further validate recommendations to enhance value of care in gastroenterology and hepatology.

I. GASTROINTESTINAL CANCER

IA. Esophageal Cancer

Q1. Can reliable screening for Barrett's esophagus and esophageal cancer be performed accurately without endoscopy?—Effective cancer prevention relies on an easy to perform, accurate and inexpensive screening test. This need is essential in esophageal cancer because of its common presentation at advanced stages;[11] there is now evidence that screening for esophageal adenocarcinoma among patients with Barrett's esophagus can identify patients at earlier stages and reduce mortality.[12,13]

A recent international consensus panel[14] has provided important guidance on management of Barrett's esophagus without high grade dysplasia or cancer. This guidance includes: First, screening only high-risk individuals (males > 60 years old with chronic uncontrolled reflux). Second, for any degree of dysplasia, at least two specialist gastrointestinal pathologists are required to concur in their opinion. Third, surveillance was not recommended for patients with <5 years of life expectancy. Fourth, management strategies for indefinite and low grade dysplasia were identified, including a de-escalation strategy for lower-risk patients and escalation to intervention with follow-up for higher-risk patients.

With this guidance, the question has to be posed: Can reliable screening for Barrett's esophagus and esophageal cancer be performed accurately without endoscopy?

One alternative to upper gastrointestinal endoscopy with biopsy for more general population screening is to sample esophageal mucosa through the passage of a swallowed string-attached sponge device.[15] A 504-participant study performed in twelve United Kingdom general practices assessed accuracy of the sponge device compared to endoscopy for Barrett's screening. It showed sensitivity and specificity of the test was 73.3% and 93.8% respectively for >1cm long, and 90.0% and 93.5% respectively for >2cm long Barrett's esophagus. This strategy provides high value by using a less expensive test than endoscopy and can be utilized more easily in large populations of patients requiring screening.[16] It may also be effective in screening for squamous cell carcinoma of the esophagus, the most common esophageal cancer worldwide.[17]

Proposed guidance: Non-endoscopic approaches, particularly a sponge device, are promising tools for screening for esophageal cancer. However, further studies are necessary before use of a sponge device instead of endoscopic biopsies can be recommended.

IB. Pancreatic Cancer

Q2. Is it possible to differentiate malignant and benign cysts in the pancreas?

—The availability of accurate cross-sectional abdominal imaging with CT and magnetic resonance imaging (MRI) commonly identifies of cystic lesions in the pancreas. In a study of 616 consecutive patients undergoing MRI, pancreatic cysts were found in 13.5% of patients over a 1-year period.[18] Determination of the benign or malignant nature of the cyst is needed. The Sendai Consensus Guidelines[19] (Table 2), updated in 2012[20] (Table 2), were formulated to guide the management of mucinous cystic lesions of the pancreas (CLPs).

The main limitation of the original Sendai guidelines was a low positive predictive value, leading to many benign neoplasms being resected. Updated guidelines improved the positive predictive value over the Sendai guidelines, although several studies validating these guidelines demonstrated that the positive predictive value remained low. In addition, although negative predictive value was high, there were still some malignant intraductal papillary mucinous neoplasms (IPMNs) missed.[21]

In a study of 114 patients with resected mucinous CLPs, the presence of symptoms, obstructive jaundice, elevated serum carcinoembryonic antigen (CEA)/carbohydrate antigen (CA)19-9, solid component, and main pancreatic duct ≥10mm were associated on univariate analysis with high grade dysplasia/invasive carcinoma in all mucinous CLPs.[22] The positive predictive values of high risk features based on Sendai and International Consensus Guidelines for high grade dysplasia/invasive carcinoma were 46% and 62.5% respectively, with a negative predictive value for low risk features of 100%. These data suggest that the guidelines for cross-sectional imaging (especially International Consensus from 2012[20]) were useful in the initial evaluation of mucinous CLPs. Furthermore, when these imaging criteria are used in combination with the selected symptoms and serum tests, the cost of diagnosis is lowered. Nevertheless, this field remains controversial, with the American Gastroenterological Association Clinical Guideline favoring conservative management of asymptomatic neoplastic pancreatic cysts.[23,24] Content experts in the field recommend the need for more data before developing management guidelines and the need for individualized assessment and management.[21,25]

Proposed Guidance: In addition to imaging of the cyst itself for presence of a solid component, the measurement of pancreatic duct diameter as well as other data, including obstructive jaundice and serum CEA and CA19-9 levels, could guide clinical appraisal of pancreatic cysts and enhance their management, while we await more definitive guidelines based on strong evidence.

Q3. What is the preferred imaging method for loco-regional staging of pancreatic cancer?—

The utility of abdominal ultrasound for diagnosis and staging of patients with pancreatic adenocarcinoma is limited. In contrast, CT using a pancreas protocol has sensitivity for diagnosis of pancreatic adenocarcinoma of 89–97% and a

positive predictive value for predicting unresectability in 89–100%. However, the positive predictive value of CT for predicting resectability (45–79%) and identification of small hepatic and peritoneal metastases present limitations. MRI enhances results from CT, particularly for evaluation of small hepatic lesions not fully characterized by CT.[26] EUS is considered superior to CT for the diagnosis and local staging of pancreatic cancer (except in the presence of underlying chronic pancreatitis[27]), but EUS does not detect distant metastases.

PET as an adjunct to conventional imaging in the staging of pancreatic adenocarcinoma is controversial. In a study of PET in identifying metastatic disease and evaluating the prognostic potential of standard uptake value (SUV) in 123 patients, PET was more sensitive in identifying pancreatic metastatic lesions than CT or MRI; however, it had a lower specificity (differentiating benign from malignant pancreatic masses), lower positive predictive value and, in some cases, delayed definitive surgical management.[28] In the evaluation by combined PET and contrast enhanced CT of 31 stage IV-A resectable pancreatic cancers, the diagnostic accuracy was >80% for local invasion, 94% for distant metastasis, but only 42% for lymph node metastasis. Overall, SUV may be a useful indicator for the treatment response and diagnosis of the post-operative recurrence.[29]

In addition, ^{18}F-FDG PET/CT provided added value in differentiating malignant from benign causes of obstructive jaundice (66 malignant, 19 benign lesions) compared to conventional imaging (enhanced CT and/or MRI). Thus sensitivity increased by 20% to 95.5%, specificity decreased by 10.5%, and overall accuracy increased by 13% (to 87.1%) over conventional imaging alone.[30] Although the utility of PET-CT is limited specifically to pancreatic cancer in this study, the avoidance of endoscopic ultrasound and noninvasive monitoring of response to therapy could provide increased value through lower cost and greater safety.

Proposed guidance: Current evidence suggests that PET-CT is the preferred initial method for loco-regional staging of pancreatic cancer.

IC. Colorectal Cancer

Q4. Should we use symptoms and alarm features to diagnose patients with colorectal cancer?—Strategies that can reduce mortality from colorectal cancer include optimally screening asymptomatic individuals or identifying sensitive and specific symptoms to allow early identification. A systematic review and meta-analysis (that screened 205 publications) examined data from 15 studies[31] that included 19,443 patients, with a pooled prevalence of colorectal carcinoma of 6% (95% CI 5% to 8%). Pooled sensitivity of alarm features was poor (5% to 64%), but specificity was >95% for dark red rectal bleeding and abdominal mass, which strongly suggest a diagnosis of colorectal cancer. This study underscores the utility of including colonoscopy to achieve early diagnosis of colorectal cancer and potentially provide definitive resection, thus avoiding the additional cost of surgery.

Proposed guidance: In view of the poor sensitivity and specificity of alarm features, the *diagnosis* of colorectal carcinoma remains best achieved through robust screening and

surveillance programs and procedures (dominated by colonoscopy) to prevent colorectal cancer in an asymptomatic population.[32] This is consistent with the evidence in the guidelines for screening,[33] surveillance after screening and polypectomy,[34] or after prior colonic surgery for colorectal cancer.[35] For further recommendations, the reader is referred to the cited references.[33–35]

II. FUNCTIONAL GASTROINTESTINAL DISORDERS

IIA. Irritable Bowel Syndrome and Dyspepsia

Q5. Should we screen for celiac disease in patients with suspected irritable bowel syndrome (IBS) or dyspepsia?—Given the low cost of TTg-IgA screening for celiac disease, the presentation with a wide variety of symptoms, and substantial and rapid improvement of symptoms,[36] a case could be made for screening even in a low prevalence disease. However, several studies suggest that not all patients with nonconstipated IBS should undergo screening for celiac disease (CD). In a study of 492 patients in the United States with symptoms of non-constipated IBS compared to 458 asymptomatic individuals undergoing colonoscopy for cancer screening or polyp surveillance (controls), the adjusted odds ratio for presence of CD-associated antibodies was 1.49 (95% confidence interval: 0.76–2.90; p=0.25), suggesting that the prevalence of CD among patients with non-constipated IBS is similar to controls.[37] These observations were confirmed in a study from Olmsted County, MN[38] in which the prevalence of seropositivity for tissue transglutaminase (TTg)-IgA was no different in dyspepsia or IBS compared to asymptomatic controls. These results were further confirmed in another study involving 3202 Olmsted County residents,[39] which concluded that the prevalence of a positive test for celiac disease in IBS patients may be similar to that found with population-based screening in the United States [1.0% (95% CI, 0.7%–1.4%)].

Proposed guidance: There is no indication to screen all patients with FD or IBS for CD; screening, which can be accomplished inexpensively by TTg-IgA screening, should be reserved for those with strong family history or features suggesting malabsorption.

Q6. Should we perform colonoscopy and colonic biopsies in suspected IBS? —IBS is a chronic condition with non-specific gastrointestinal symptoms that occurs in 10–15% of the Western population.[40] As a result, studies that better define the role of colonoscopy and its ability to change diagnosis and treatment in patients with IBS symptoms are crucial.

In a prospective, case-controlled study conducted at three U.S. sites,[41] 466 patients with suspected non-constipated IBS undergoing colonoscopy with rectosigmoid biopsies were compared to persons undergoing colonoscopy for colorectal cancer screening or polyp surveillance.. Patients with suspected IBS had higher prevalence of mucosal erythema or ulceration (4.9% vs. 1.8% controls; p<0.01) and overall prevalence of microscopic colitis of 1.5%, slightly higher (2.3%) in those ≥45 years of age. A recent systematic review reported that, although a third of patients with microscopic colitis have symptoms of IBS, the odds of microscopic colitis were no higher in patients with IBS compared with other patients with diarrhea, and concluded that the value of routine colonoscopy and biopsy to exclude

microscopic colitis in patients with typical IBS symptoms remains uncertain, unless other risk factors or alarm symptoms are present.[42]

Proposed Guidance: Given the low prevalence of microscopic colitis in patients with nonconstipated IBS, these data suggest that colonoscopy and colonic biopsies should not be performed routinely in patients with IBS unless there are other approved indications for the colonoscopy or persistent chronic diarrhea, particularly in those >45 years of age.

Q7. Should we use breath hydrogen or methane measurements to test for small intestinal bacterial overgrowth in patients with IBS?—Small intestinal bacterial overgrowth (SIBO) is historically associated with small bowel stasis or immunodeficiency. With the widespread use of proton pump inhibitors (PPIs) which predispose to SIBO,[43] the reported association with IBS (reviewed in ref. 44), and approval of a non-absorbable antibiotic, rifaximin, for the treatment of IBS-diarrhea (IBS-D),[45] the diagnosis of SIBO in patients with IBS-D has become more relevant.

Unfortunately, the use of lactulose (LHBT)- or glucose (GHBT)-hydrogen breath tests to diagnose SIBO has been questioned, as false positives could reflect rapid orocecal transit from delivery of the substrate to the colon and fermentation by colonic bacteria. Two studies (using concurrent radioscintigraphy and breath H_2 and CH_4 measurements) have confirmed that abnormal rise in H_2 or CH_4 measured in the LHBT (based on >15 or 20 parts per million above baseline within 90 minutes of ingestion) can occur from variations in orocecal transit time in IBS patients, rather than SIBO.[46,47] In one study,[46] at the time of increase in H_2, there was 5% accumulation of ^{99m}Tc in the cecum (indicating the arrival of the leading edge of chyme in the colon) in 88% of cases. In the second study,[47] 48% of breath tests in 139 patients were false-positives.

Other investigators have compared positive breath tests with cultures from duodenal aspirates[48] in 139 patients with unexplained gas, bloating and diarrhea and negative endoscopy, imaging and blood tests. The GHBT was positive in 16/25 patients (64%) with bacterial counts of $\geq 10^5$CFU/mL, with the negative agreement of 92/114 (80.7%) subjects. The positive predictive value of GHBT for SIBO was <45%. Although breath testing is neither expensive nor invasive, avoiding its use in this large patient population can substantially lower healthcare costs.

Proposed Guidance: Given that positive breath hydrogen tests may be recorded in up to 40% of controls,[49] these tests should not be performed in patients with symptoms consistent with IBS in whom there are no features suggesting malabsorption.

IIB. Constipation

Q8. Should we perform defecography in patients with constipation?—It is estimated that >25% of patients presenting with constipation to referral gastroenterologists have evidence of rectal evacuation disorders due to pelvic floor or anal sphincter dysfunction.[50] These disorders should be suspected in patients with constipation not responding to first line therapies including increase in dietary fiber intake[51] and in patients with symptoms such as excessive straining to pass bowel movements that suggest rectal

evacuation disorders. Therefore, tests of pelvic floor dysfunction yield the correct diagnosis, impact selection of physical therapy[52,53] and obviate the need for low yield or invasive and expensive testing involving imaging, as well as avoiding prolonged periods of ineffective treatments for constipation.

To examine the diagnostic yield of colorectal tests, 100 patients with difficult defecation were prospectively evaluated with anorectal manometry, balloon expulsion, colonic transit and defecography.[54] Among 70 patients with abnormal anorectal manometry, 64% had slow colonic transit, 60% had impaired balloon expulsion, and 37% had abnormal defecography. The defecography provided no additional discriminant utility.

Proposed Guidance: Defecography is not recommended in the routine evaluation of patients with constipation. Additional data support the balloon expulsion test as the best first test to identify evacuation disorders.[55]

III. INFLAMMATORY BOWEL DISEASE

Q9. Which symptoms at first presentation are predictive of inflammatory bowel disease (IBD) and who should undergo further testing among patients presenting with lower GI symptoms? Are there biomarkers for discriminating IBD from IBS or for predicting relapse of IBD?

A recent meta-analysis showed modest accuracy of symptom-based criteria to diagnose IBS and exclude more worrisome diseases such as IBD.[56] As a result, it would be useful to determine whether individual or combinations of symptoms or biomarkers of gut inflammation help select which patients should undergo testing to identify IBD or relapses of IBD, given the increased appreciation of IBS symptoms in patients with IBD.[57]

In a study of 1982 consecutive adult patients with lower gastrointestinal symptoms at two hospitals in Hamilton, Ontario, Canada,[58] independent predictors of the 302 IBD patients after logistic regression analysis were family history of IBD, younger age, >4 stools per day ≥75% of the time, persistent fecal urgency, and anemia. These items individually did not predict a diagnosis of ulcerative colitis or Crohn’s disease, suggesting that biological markers in combination with symptoms are needed to improve accuracy. In fact, measurements of fecal calprotectin (a neutrophil-specific marker) and lactoferrin discriminate IBD from IBS and addition of serum anti-Saccharomyces cervisiae antibody (ASCA) and perinuclear antineutrophil cytoplasmic antibodies (pANCA) provided only marginal additional diagnostic accuracy[59] Serum CRP of ≤0.5 or fecal calprotectin of ≤40μg/g (or mg/L) essentially excludes IBD in patients with IBS symptoms.[60]

Identifying relapsers in a cross-sectional cohort of IBD has important implications for prognosis and treatment. Stool calprotectin was tested initially in 43 patients with Crohn's disease and 37 with ulcerative colitis in clinical remission; among those cohorts, 58% of patients with Crohn’s disease and 51% with ulcerative colitis had a relapse over the following 12 months. Median calprotectin levels in the relapse groups (122mg/L for Crohn’s disease, 123mg/L for ulcerative colitis; normal <10mg/L) differed significantly ($p<0.0001$) from those with sustained remission (41.5mg/L for Crohn’s disease, 29.0mg/L for ulcerative

colitis). Calprotectin levels of 50mg/L had 90% sensitivity and 83% specificity for predicting relapse in patients with IBD.[61] The use of biomarkers to assess for the presence and/or disease activity of IBD could lead to significant cost savings by avoiding expensive radiological imaging or invasive endoscopy. Furthermore, given the high prevalence of IBS in the population (estimated at ~15% in Western countries), biomarker tests (e.g. normal fecal calprotectin) could avoid the need for colonoscopy in large numbers of patients.

Proposed Guidance—Fecal calprotectin measurement in combination with other clinical and laboratory findings can be used to differentiate IBS from IBD and to predict the likelihood of relapse in IBD.

IV. HEPATOBILIARY DISORDERS

Q10. What imaging tests should be done in the jaundiced patient? How should we stage biliary strictures?

Imaging studies are essential in the diagnosis and management of patients with obstructive jaundice, particularly to determine if the cause is benign or malignant. Ultrasound is the first test, due to its low cost, ease of performance and availability; in addition, patients often require advanced imaging with CT, endoscopic retrograde cholangiopancreatography (ERCP), MRCP magnetic resonance cholangiopancreatography (MRCP), EUS, or combinations,[62] as they provide greater anatomic accuracy and could be therapeutic. The relative advantages and utility of the different tests are shown in Table 3.

In a prospective study of 50 patients (mean age 65.7 years) with painless jaundice suspected to have biliary strictures,[63] the performance of the different tests was similar in the 40 patients who underwent all four imaging methods (Table 4). MRCP had limited specificity for the diagnosis of malignant strictures because of the lack of tissue diagnosis.

On the other hand, in an analysis of 54 benign and 21 malignant biliary strictures assessed by MRCP, the finding of irregular, asymmetric and long segment narrowing was more common in malignant strictures, and diagnostic accuracy was 93.3%, sensitivity 85.7%, and specificity 96.3% relative to final diagnosis based on surgical, ERCP, and histopathological outcomes.[64] In contrast, benign strictures were regular, symmetric and had short segment narrowing. Moreover, MRI has an important role in preoperative assessment of resectability. Thus, MRI (including MRCP) and the coronal liver acquisition with volume acceleration (LAVA) technique showed 85.4% accuracy, 90.9% sensitivity, 78.9% specificity, 83.3% positive and 88.2% negative predictive values for resectability of low biliary level malignant strictures presenting with obstructive jaundice.[65] These studies support the use of MRCP as an initial and accurate test for assessing bile duct strictures and help identify which patients should undergo other radiologic and endoscopic tests, thereby reducing costs and, potentially, risks associated with care.

Proposed Guidance—MRCP should be performed after ultrasound in patients with suspected biliary strictures; MRCP provides anatomic accuracy and assesses resectability in patients with malignant strictures. EUS may then be reserved for cases that are resectable, when preoperative tissue diagnosis is required.

CONCLUSION

This review of twelve commonly encountered clinical practice questions in gastroenterology and hepatology identifies less invasive testing and suggests that, in some (but not all) conditions, clinical features may help select patients with gastrointestinal symptoms for further testing. In addition, the literature is analyzed to appraise the clinical utility and accuracy of tests, either alone or in combination, that are associated with higher diagnostic accuracy and high value patient care. However, these examples are merely a first step in the examination of current evidence towards the goal to promote further study and enhance the value of care in gastroenterology. Further advances in some of these topics in gastroenterology practice will require well conducted, large-sample, cohort studies, preferably in different demographic groups, followed by large, pragmatic, clinical trials.

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Abbreviations used

CD	celiac disease
CLP	cystic lesions of the pancreas
CT	computerized tomography
EoE	eosinophilic esophagitis
ERCP	endoscopic retrograde cholangiopancreatography
EUS	endoscopic ultrasound
FDG	fluoro-deoxy glucose
IBD	inflammatory bowel disease
IBS	irritable bowel syndrome
IPMN	intraductal papillary mucinous neoplasm
LAVA	liver acquisition with volume acceleration
MRCP	magnetic resonance cholangiopancreatography
MRI	magnetic resonance imaging
PET	positron emission tomography
PPI	proton pump inhibitor
PTC	percutaneous transhepatic cholangiography
SIBO	small intestinal bacterial overgrowth

SUV	standard uptake volume
TNM	classification of malignant tumors
US	ultrasound

REFERENCES

1. Center for Sustainable Health Spending. Health Sector Economic Indicators. Insights from monthly national health spending data through July 2015. [Accessed March 1, 2016] http://altarum.org/sites/default/files/uploaded-related-files/CSHS-Spending-Brief_September_2015.pdf.
2. Owens DK, Qaseem A, Chou R, Shekelle P. Clinical Guidelines Committee of the American College of Physicians. High-value, cost-conscious health care: concepts for clinicians to evaluate the benefits, harms, and costs of medical interventions. Ann Intern Med. 2011; 154:174–180. [PubMed: 21282697]
3. Peery AF, Crockett SD, Barritt AS, et al. Burden of gastrointestinal, liver, and pancreatic diseases in the United States. Gastroenterology. 2015; 149:1731–1741. [PubMed: 26327134]
4. U.S. Food and Drug Administration. [Accessed March 1, 2016] Reducing radiation from medical x-rays. This article appears on FDA's Consumer Updates page, which features the latest on all FDA-regulated products. Date Posted: February 19, 2009. http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm095505.htm
5. Image Wisely and US Food and Drug Administration. My Medical Imaging History. [Accessed March 1, 2016] http://www.radiologyinfo.org/en/safety/ImageWisely/7678_Medical%20Imaging%20History.pdf.
6. Bressler B, Marshall JK, Bernstein CN, et al. Clinical practice guidelines for the medical management of nonhospitalized ulcerative colitis: the Toronto consensus. Gastroenterology. 2015; 148:1035–1058. e3. [PubMed: 25747596]
7. Abraham NS, Richardson P, Castillo D, Kane SV. Dual therapy with infliximab and immunomodulator reduces one-year rates of hospitalization and surgery among veterans with inflammatory bowel disease. Clin Gastroenterol Hepatol. 2013; 11:1281–1287. [PubMed: 23792295]
8. David G, Gunnarsson C, Lofland JH. Variations in care: a retrospective database analysis of healthcare utilization patterns for patients with inflammatory bowel disease. J Med Econ. 2015; 18:137–144. [PubMed: 25335098]
9. American Gastroenterological Association. Choosing Wisely. Five things physicians and patients should question. [Accessed March 1, 2016] http://www.gastro.org/practice-management/quality/choosing-wisely.
10. Laine C. High-value testing begins with a few simple questions. Ann Intern Med. 2012; 156:162–163. [PubMed: 22250151]
11. Dulai GS, Guha S, Kahn KL, et al. Preoperative prevalence of Barrett's esophagus in esophageal adenocarcinoma: a systematic review. Gastroenterology. 2002; 122:26–33. [PubMed: 11781277]
12. Qiao Y, Hyder A, Bae SJ, et al. Surveillance in patients with Barrett's esophagus for early detection of esophageal adenocarcinoma: a systematic review and meta-analysis. Clin Transl Gastroenterol. 2015 Dec 10.6:e131. [PubMed: 26658838]
13. Kastelein F, van Olphen S, Steyerberg EW, et al. Surveillance in patients with long-segment Barrett's oesophagus: a cost-effectiveness analysis. Gut. 2015; 64:864–871. [PubMed: 25037191]
14. Bennett C, Moayyedi P, Corley DA, et al. BOB CAT: A large-scale review and Delphi consensus for management of Barrett's esophagus with no dysplasia, indefinite for, or low-grade dysplasia. Am J Gastroenterol. 2015; 110:662–682. [PubMed: 25869390]
15. Kadri SR, Lao-Sirieix P, O'Donovan M, et al. Acceptability and accuracy of a non-endoscopic screening test for Barrett's oesophagus in primary care: cohort study. BMJ. 2010; 341:c4372. [PubMed: 20833740]

16. Benaglia T, Sharples LD, Fitzgerald RC, et al. Health benefits and cost effectiveness of endoscopic and nonendoscopic cytosponge screening for Barrett's esophagus. Gastroenterology. 2013; 144:62–73. e6. [PubMed: 23041329]
17. Roshandel G, Merat S, Sotoudeh M, et al. Pilot study of cytological testing for oesophageal squamous cell dysplasia in a high-risk area in Northern Iran. Br J Cancer. 2014; 111:2235–2241. [PubMed: 25247319]
18. Lee KS, Sekhar A, Rofsky NM, et al. Prevalence of incidental pancreatic cysts in the adult population on MR imaging. Am J Gastroenterol. 2010; 105:2079–2084. [PubMed: 20354507]
19. Tanaka M, Chari S, Adsay V, et al. International consensus guidelines for management of intraductal papillary mucinous neoplasms and mucinous cystic neoplasms of the pancreas. Pancreatology. 2006; 6:7–32. [PubMed: 16327280]
20. Tanaka M, Fernández-del Castillo C, Adsay V, et al. International consensus guidelines 2012 for the management of IPMN and MCN of the pancreas. Pancreatology. 2012; 12:183–197. [PubMed: 22687371]
21. Goh BK. International guidelines for the management of pancreatic intraductal papillary mucinous neoplasms. World J Gastroenterol. 2015; 21:9833–9837. [PubMed: 26379390]
22. Goh BK, Thng CH, Tan DM, et al. Evaluation of the Sendai and 2012 International Consensus Guidelines based on cross-sectional imaging findings performed for the initial triage of mucinous cystic lesions of the pancreas: a single institution experience with 114 surgically treated patients. Am J Surg. 2014; 208:202–209. [PubMed: 24530043]
23. Vege SS, Ziring B, Jain R, et al. American Gastroenterological Association Institute guideline on the diagnosis and management of asymptomatic neoplastic pancreatic cysts. Gastroenterology. 2015; 148:819–822. [PubMed: 25805375]
24. Moayyedi P, Weinberg DS, Schünemann H, et al. Management of pancreatic cysts in an evidence-based world. Gastroenterology. 2015; 148:692–695. [PubMed: 25724461]
25. Fernández-del Castillo C, Tanaka M. Management of pancreatic cysts: The evidence is not here yet. Gastroenterology. 2015; 148:685–687. [PubMed: 25724457]
26. Wong JC, Lu DS. Staging of pancreatic adenocarcinoma by imaging studies. Clin Gastroenterol Hepatol. 2008; 6:1301–1308. [PubMed: 18948228]
27. Krishna NB, Mehra M, Reddy AV, et al. EUS/EUS-FNA for suspected pancreatic cancer: influence of chronic pancreatitis and clinical presentation with or without obstructive jaundice on performance characteristics. Gastrointest Endosc. 2009; 70:70–79. [PubMed: 19249774]
28. Einersen P, Epelboym I, Winner MD, et al. Positron emission tomography (PET) has limited utility in the staging of pancreatic adenocarcinoma. J Gastrointest Surg. 2014; 18:1441–1444. [PubMed: 24928186]
29. Asagi A, Ohta K, Nasu J, et al. Utility of contrast-enhanced FDG-PET/CT in the clinical management of pancreatic cancer: impact on diagnosis, staging, evaluation of treatment response, and detection of recurrence. Pancreas. 2013; 42:11–19. [PubMed: 22699206]
30. Wang SB, Wu HB, Wang QS, et al. ^{18}F-FDG PET/CT in differentiating malignant from benign origins of obstructive jaundice. Hepatobiliary Pancreat Dis Int. 2015; 14:516–522. [PubMed: 26459728]
31. Ford AC, Veldhuyzen van Zanten SJ, Rodgers CC, et al. Diagnostic utility of alarm features for colorectal cancer: systematic review and meta-analysis. Gut. 2008; 57:1545–1553. [PubMed: 18676420]
32. Lieberman DA. American Gastroenterological Association. Colon polyp surveillance: clinical decision tool. Gastroenterology. 2014; 146:305–306. [PubMed: 24269291]
33. Levin B, Lieberman DA, McFarland B, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. CA Cancer J Clin. 2008; 58:130–160. [PubMed: 18322143]
34. Lieberman DA, Rex DK, Winawer SJ, et al. Guidelines for colonoscopy surveillance after screening and polypectomy: a consensus update by the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology. 2012; 143:844–857. [PubMed: 22763141]

35. Kahi CJ, Boland CR, Dominitz JA, et al. Colonoscopy surveillance after colorectal cancer resection: recommendations of the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology. 2016; 150:758–768. [PubMed: 26892199]
36. Murray JA, Watson T, Clearman B, Mitros F. Effect of a gluten-free diet on gastrointestinal symptoms in celiac disease. Am J Clin Nutr. 2004; 79:669–673. [PubMed: 15051613]
37. Cash BD, Rubenstein JH, Young PE, et al. The prevalence of celiac disease among patients with nonconstipated irritable bowel syndrome is similar to controls. Gastroenterology. 2011; 141:1187–1193. [PubMed: 21762658]
38. Locke GR 3rd, Murray JA, Zinsmeister AR, et al. Celiac disease serology in irritable bowel syndrome and dyspepsia: a population-based case-control study. Mayo Clin Proc. 2004; 79:476–482. [PubMed: 15065612]
39. Choung RS, Rubio-Tapia A, Lahr BD, et al. Evidence against routine testing of patients with functional gastrointestinal disorders for celiac disease: A population-based study. Clin Gastroenterol Hepatol. 2015; 13:1937–1943. [PubMed: 25987301]
40. Chey WD, Kurlander J, Eswaran S. Irritable bowel syndrome: a clinical review. JAMA. 2015; 313:949–958. [PubMed: 25734736]
41. Chey WD, Nojkov B, Rubenstein JH, et al. The yield of colonoscopy in patients with non-constipated irritable bowel syndrome: results from a prospective, controlled US trial. Am J Gastroenterol. 2010; 105:859–865. [PubMed: 20179696]
42. Kamp EJ, Kane JS, Ford AC. Irritable Bowel Syndrome and Microscopic Colitis: A Systematic Review and Meta-analysis. Clin Gastroenterol Hepatol. 2016; 14:659.e1–668.e1. [PubMed: 26453949]
43. Fujiwara Y, Watanabe T, Muraki M, et al. Association between chronic use of proton pump inhibitors and small- intestinal bacterial overgrowth assessed using lactulose hydrogen breath tests. Hepato-Gastroenterology. 2015; 62:268–272. [PubMed: 25916046]
44. Ford AC, Spiegel BM, Talley NJ, et al. Small intestinal bacterial overgrowth in irritable bowel syndrome: systematic review and meta-analysis. Clin Gastroenterol Hepatol. 2009; 7:1279–1286. [PubMed: 19602448]
45. Pimentel M, Lembo A, Chey WD, et al. Rifaximin therapy for patients with irritable bowel syndrome without constipation. N Engl J Med. 2011; 364:22–32. [PubMed: 21208106]
46. Yu D, Cheeseman F, Vanner S. Combined oro-caecal scintigraphy and lactulose hydrogen breath testing demonstrate that breath testing detects oro-caecal transit, not small intestinal bacterial overgrowth in patients with IBS. hydrogen measurements. Gut. 2011; 60:334–340. [PubMed: 21112950]
47. Lin EC, Massey BT. Scintigraphy demonstrates high rate of false-positive results from glucose breath tests for small bowel bacterial overgrowth. Clin Gastroenterol Hepatol. 2015 Aug 1. pii: S1542-3565(15)01047-2. [Epub ahead of print].
48. Erdogan A, Rao SS, Gulley D, et al. Small intestinal bacterial overgrowth: duodenal aspiration vs glucose breath test. Neurogastroenterol Motil. 2015; 27:481–489. [PubMed: 25600077]
49. Ghoshal UC, Srivastava D. Irritable bowel syndrome and small intestinal bacterial overgrowth: meaningful association or unnecessary hype. World J Gastroenterol. 2014; 20:2482–2491. [PubMed: 24627585]
50. Nullens S1, Nelsen T, Camilleri M, et al. Regional colon transit in patients with dys-synergic defaecation or slow transit in patients with constipation. Gut. 2012; 61:1132–1139. [PubMed: 22180057]
51. Voderholzer WA, Schatke W, Mühldorfer BE, et al. Clinical response to dietary fiber treatment of chronic constipation. Am J Gastroenterol. 1997; 92:95–98. [PubMed: 8995945]
52. Rao SS, Benninga MA, Bharucha AE, et al. ANMS-ESNM position paper and consensus guidelines on biofeedback therapy for anorectal disorders. Neurogastroenterol Motil. 2015; 27:594–609. [PubMed: 25828100]
53. Woodward S, Norton C, Chiarelli P. Biofeedback for treatment of chronic idiopathic constipation in adults. Cochrane Database Syst Rev. 2014 Mar 26.3:CD008486. [PubMed: 24668156]

54. Rao SS, Mudipalli RS, Stessman M, et al. Investigation of the utility of colorectal function tests and Rome II criteria in dyssynergic defecation (Anismus). Neurogastroenterol Motil. 2004; 16:589–596. [PubMed: 15500515]
55. Minguez M, Herreros B, Sanchiz V, et al. Predictive value of the balloon expulsion test for excluding the diagnosis of pelvic floor dyssynergia in constipation. Gastroenterology. 2004; 126:57–62. [PubMed: 14699488]
56. Sood R, Gracie DJ, Law GR, et al. Systematic review with meta-analysis: the accuracy of diagnosing irritable bowel syndrome with symptoms, biomarkers and/or psychological markers. Aliment Pharmacol Ther. 2015; 42:491–503. [PubMed: 26076071]
57. Camilleri M. Lead Article: Managing symptoms of irritable bowel syndrome in inflammatory bowel disease patients. Gut. 2011; 60:425–428. [PubMed: 21292684]
58. Ford AC, Moayyedi P, Bercik P, et al. Lack of utility of symptoms and signs at first presentation as predictors of inflammatory bowel disease in secondary care. Am J Gastroenterol. 2015; 110:716–724. [PubMed: 25916225]
59. Schoepfer AM, Trummler M, Seeholzer P, et al. Discriminating IBD from IBS: comparison of the test performance of fecal markers, blood leukocytes, CRP, and IBD antibodies. Inflamm Bowel Dis. 2008; 14:32–39. [PubMed: 17924558]
60. Menees SB, Powell C, Kurlander J, et al. A meta-analysis of the utility of C-reactive protein, erythrocyte sedimentation rate, fecal calprotectin, and fecal lactoferrin to exclude inflammatory bowel disease in adults with IBS. Am J Gastroenterol. 2015; 110:444–454. [PubMed: 25732419]
61. Tibble JA, Sigthorsson G, Bridger S, et al. Surrogate markers of intestinal inflammation are predictive of relapse in patients with inflammatory bowel disease. Gastroenterology. 2000; 119:15–22. [PubMed: 10889150]
62. Tse F, Barkun JS, Romagnuolo J, et al. Nonoperative imaging techniques in suspected biliary tract obstruction. HPB (Oxford). 2006; 8:409–425. [PubMed: 18333096]
63. Rösch T, Meining A, Frühmorgen S, et al. A prospective comparison of the diagnostic accuracy of ERCP, MRCP, CT, and EUS in biliary strictures. Gastrointest Endosc. 2002; 55:870–876. [PubMed: 12024143]
64. Suthar M, Purohit S, Bhargav V, et al. Role of MRCP in differentiation of benign and malignant causes of biliary obstruction. J Clin Diagn Res. 2015; 9:TC08–TC12. [PubMed: 26675498]
65. Sun N, Xu Q, Liu X, et al. Comparison of preoperative evaluation of malignant low-level biliary obstruction using plain magnetic resonance and coronal liver acquisition with volume acceleration technique alone and in combination. Eur J Med Res. 2015; 20:92. [PubMed: 26607835]

Table 1

American Gastroenterological Association Recommendations in Choosing Wisely Campaign

Recommended Choice
For pharmacological treatment of patients with gastroesophageal reflux disease (GERD), long-term acid suppression therapy (proton pump inhibitors or histamine2 receptor antagonists) should be titrated to the lowest effective dose needed to achieve therapeutic goals.
Do not repeat colorectal cancer screening (by any method) for 10 years after a high-quality colonoscopy is negative in average-risk individuals.
Do not repeat colonoscopy for at least five years for patients who have one or two small (<1cm) adenomatous polyps, without high-grade dysplasia, completely removed via a high-quality colonoscopy.
For a patient who is diagnosed with Barrett's esophagus, who has undergone a second endoscopy that confirms the absence of dysplasia on biopsy, a follow-up surveillance examination should not be performed in less than three years as per published guidelines.
For a patient with functional abdominal pain syndrome (as per ROME III criteria) computed tomography (CT) scans should not be repeated unless there is a major change in clinical findings or symptoms.

Table 2

Summary of the Sendai Consensus Guidelines (SCG) and International Consensus Guidelines (ICG) for Selecting Patients with Pancreatic Cysts for Surgical Resection (refs. 19,20)

Guideline	Criteria
SENDAI Consensus Guidelines	
MD-IPMN	MPD ≥10mm
SCG +ve BD-IPMN	Size >3cm
	Size ≤3cm with symptoms/mural nodules/MPD dilation (>6mm)/+ve cytology
International Consensus Guidelines	
High risk features	Proximal lesion with obstructive jaundice
	Enhancing nodules
	Dilated main duct (≥10mm)
Worrisome risk features	Size ≥3cm
	Pancreatitis
	Non-enhancing nodules
	Thickened, enhancing walls
	Dilated duct (5 to <10mm)
	Change in duct caliber with distal atrophy
	Lymphadenopathy

MPD: Main pancreatic duct; MD-IPMN: Main-duct intraductal papillary mucinous neoplasm; BD-IPMN: Branch-duct intraductal papillary mucinous neoplasm.

Table 3

Relative Advantages and Utility of the Different Tests for Suspected Biliary Obstruction (ref. 62)

Indirect			Direct			
Imaging modality	**US**	**Helical CT cholangiogram**	**MRCP + abdo MRI**	**EUS**	**ERCP**	**PTC**
Portability	+++	−	−	++	+	−
Safety	+++	++	+++	++	+	+
Operator dependence	+++	+	++	+++	++	++
Low cost	+++	+	+	+	+	++
Staging cancer	+	+++	+++	+++	−	−
Tissue sampling	+	+	−	+++	+++	++
Therapy	−	−	−	+	+++	+++

US=ultrasound; CT=computerized tomography; MRCP= magnetic resonance cholangiopancreatography; EUS=endoscopic ultrasound; ERCP= endoscopic retrograde cholangiopancreatography; PTC=percutaneous transhepatic cholangiography

Table 4

Appraisal of Performance of the Different Tests for Suspected Biliary Strictures (ref. 63)

In 17 benign, 26 malignant biliary strictures	CT	MRCP	EUS	ERCP/PTC
Sensitivity	77%	85%	79%	85%
Specificity	63%	71%	62%	75%
Positive predictive value	69%	76%	76%	79%
Negative predictive value	71%	81%	66%	82%

CT=computerized tomography; MRCP= magnetic resonance cholangiopancreatography; EUS=endoscopic ultrasound; ERCP= endoscopic retrograde cholangiopancreatography; PTC=percutaneous transhepatic cholangiography