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Survey on practice patterns in imaging utilization in patients with Crohn's disease

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ABSTRACT

Purpose: To perform a survey-based assessment of imaging practice preferences in Crohn's disease (CD).
Methods: An internet-based questionnaire was sent to physicians involved in CD care. The questionnaire addressed the experience, practice patterns, choice of modality, and recent trends in imaging utilization.
Results: The response rate was 7.57% (122/1598) with 43.8% of respondents involved in care of CD for ≥10 years. CT was mostly preferred by ED physicians, internists and primary care physicians, while MRI by gastroenterologists and pediatricians. Practitioners from non-teaching facilities had higher preference for CT (CT:42% andMR:27%), compared to teaching/academic hospitals (MR:45% and CT: 40%) ($p = 0.06$). MR was preferred by pediatric practitioners compared to physicians serving older age group of patients (> 16 yrs) ($p = 0.01$). CT was preferred by physicians taking care of < 50 patients/year (CT:37, MR:27, No preference = 19) and MR preferred by physicians serving ≥50 patients/year (CT:12, MR:21, No preference:3)($p = 0.02$). CT/CT enterography was the most widely used exam (93.3%) and preferred modality for evaluation of acute CD exacerbation (87.7%), followed by assessment for new symptoms (73.7%) and extra-intestinal manifestations (61.3%). MR/MR enterography (58%) was more preferred for asymptomatic CD patients for disease surveillance.

Nearly 80% of respondents reported a change in imaging preferences, 46.5% respondents indicating growing preference for MRI while 33.3% reported increasing preference for CT. 29.6% physicians reported a patient preference for MRI over CT (13%) with the most common factor for choice of MRI being fear of harmful effects of radiation (60.2%).
Conclusion: Physician practices reported continued preference for CT in evaluation of patients with CD, particularly for evaluation of acute exacerbation, new symptoms or extra-intestinal manifestations. Physician providers with large practice volume, younger patient population and GI sub-specialty expertise report growing MRI utilization.

1. Introduction

Imaging plays an integral role in the management of patients with Crohn's disease (CD) and use of cross-sectional imaging techniques such as CT/MRI has been rising in the past decade owing to technological advances [1]. CT and MR enterography exams are particularly beneficial for evaluation of small bowel disease with high degree of concordance between imaging and endoscopic findings [2–5]. Imaging reliance among care providers of CD is also growing due to their ability to assess disease activity and identify extra-intestinal complications including abscess, fistula and bowel obstruction [2–8]. While CT and MR studies are comparable in their ability to identify intestinal and extra-intestinal manifestations of CD, there has been growing concern about the repeated use of CT and harmful effects of radiation exposure [9]. This has led to rising use of MR enterography in CD patients along with pelvic MRI for delineation of complex perianal inflammatory processes. Despite the advantage of lack of ionizing radiation and better soft-tissue visualization, MR utilization has not totally replaced CT due to long scan times, higher cost and susceptibility of the scans to motion artifacts [6]. Additionally, MRI utilization in an acute setting continues to present challenges due to patient acuity and issues with obtaining insurance approval for acutely sick patients. Given the high prevalence of IBD in the USA and significant long-term morbidity associated with this disease, adopting the best imaging modality with superior diagnostic accuracy and patient safety considerations is crucial. In our clinical practice, we

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have observed a rising trend in utilization of MR Enterography for diagnosis and follow-up of CD patients over the past decade. However, there are no larger studies in the literature, investigating the practice preferences of CD practitioners. Due to complex and chronic nature of the CD process and variability in the different types of physician groups involved in care of CD patients, we hypothesized that the practice preference for imaging utilization in CD patients might vary according to physician specialty, patient age and acuity of presentation. Studying the imaging ordering preferences and practice patterns among providers taking care of CD patients is important to understand the trends in imaging utilization. Such knowledge not only allows enhanced utilization of limited imaging resources but also provides a glimpse into the impact of patient preferences on imaging trends. We therefore conducted this multi-institutional online survey, to explore the imaging ordering practices of physicians in United States to achieve a better understanding of the factors affecting preferences for ordering of imaging studies and trends in imaging utilization in patients with CD.

2. Materials and methods

The study involved an internet based multiple-choice questionnaire (https://www.surveymonkey.com/) developed by the study investigators and sent to respondents via email. The inclusion criteria for the respondent population were: a) physician provider practicing within the U.S and b) involved in care of patients with CD. The target respondents were identified from our hospital health care group network, providers from major institution involved in care of CD, and from open access public websites for CD healthcare groups. Based on these criteria, the physician groups selected for email-based survey included gastroenterologists, pediatricians, gastrointestinal surgeons, emergency room (ER) physicians and primary care physicians of multiple institutions. The survey questionnaire was subsequently sent to the selected group of physician providers via email, which included a link to the survey. This online survey was designed to maintain anonymity and confidentiality of the responders. The online survey remained open for 90 days. Two weeks after the initial email, a reminder email was sent to all the physicians.

To ensure validity and understandability of the survey, the questions and responses were devised by a core group which included abdominal radiologists (AK and MG) with focused clinical and research interest in imaging of CD and a senior gastroenterologist (VY) exclusively involved in clinical care of CD patients. The survey questions were designed after careful consideration to understand the potential factors affecting practicing provider preferences for ordering of imaging studies and trends in imaging utilization [10–12]. The survey questionnaire included 18 multiple-choice questions designed to study practice setting, patient volume, imaging indications and imaging modality preferences of providers. The questionnaire requested information on the use of imaging in the initial diagnosis and follow up of patients with CD, as well as evaluation of suspected complications and disease exacerbations. The questionnaire also intended to address the experience of referring providers, choice of imaging modality, reasons for imaging preference and recent trends in imaging utilization. (Appendix A).

Table 1
Physicians demographics.

Summary of physician demographics	
Medical specialty	
1. Gastroenterologists	n = 34 (27.9%)
2. Internists	n = 28 (22.9%)
3. ED physicians	n = 26 (21.3%)
4. Ambulatory care	n = 17 (13.9%)
5. GI surgeons	n = 11 (9%)
6. Pediatricians	n = 5 (4.1%)
Work setting	
1. Teaching hospital	n = 83 (68%)
2. Office based	n = 21 (17.2%)
3. Nonteaching hospital	n = 13 (10.7%)
4. Academic research centers	n = 4 (3.3%)
Years of experience in the field	
1. < 5 years	n = 36 (29.5%)
2. Between 6 and 10 years	n = 32 (26.2%)
3. Between 11 and 20 years	n = 24 (19.7%)
4. > 20 years	n = 29 (24%)
Involvement of practitioners in different age groups of Crohn's patients* (with some overlap)	
• < 15 age group	n = 20 (16.4%)
• 16–30 age group	n = 64 (52.5%)
• 31–40 age group	n = 69 (56.6%)
• > 40 age group	n = 56 (45.9%)
Patient practice volume served by the physicians	
• < 10 per year	n = 33 (27%)
• 11–50 per year	n = 52 (42.6%)
• 51–100 per year	n = 18 (14.7%)
• 101–200 per year	n = 8 (6.6%)
• > 200 per year	n = 10 (8.2%)

3. Data collection and outcome measures

The survey results were analyzed using the tools provided by the third-party online survey software. The online software recorded individual responses in a blinded manner and recorded the responses made by different responders for a question. The frequency of an individual option was selected out of total individual responses and results were presented in form of percentages. The online software also generated a rank order, for the given options, according to the frequency. The software also allowed filtering and reassortment of the results based on the selected options for any given question allowing the filtering of data specific to specialty, practice type or imaging preference. A comparison of the proportions was evaluated with Chi square test by using Medcalc software Version 17.2 (MedCalc Software, Ostend, Belgium).

4. Results

4.1. Provider demographics and practice patterns

The email survey was sent to 1598 physicians including gastroenterologists, pediatricians, gastrointestinal surgeons, emergency physicians and primary care physicians. The response rate was 7.57% (122/1598) with 43.8% of respondents being involved in care of CD patients for > 10 years (19.8% for 11–20 years and 24% for > 20 years). There was no significant difference in the demographic characteristics of the responders from the total group selected for the survey. Table 1 shows

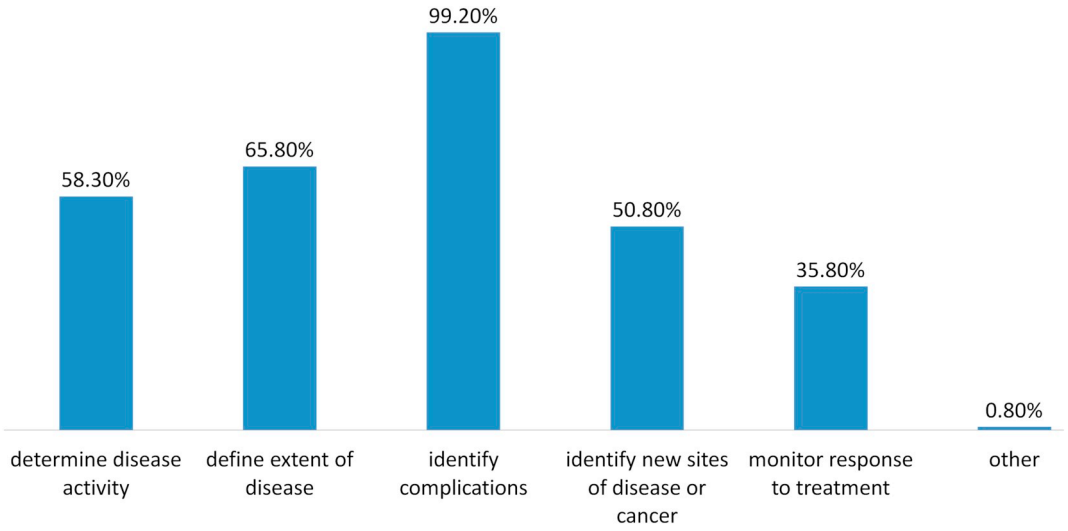

Fig. 1. Expectations from imaging. Bar diagram showing most common expectation from imaging studies was for identification of complications followed by defining extent of disease and to determine disease activity.

Table 2
Preference of CT vs. MRI in different specialties.

Medical specialty	CT	MRI	No preference
ED physicians	21(80.8%)	2(7.7%)	3(11.5%)
Internists	13(48.1%)	8(29.6%)	6(22.2%)
primary care physicians	8(50%)	2(12.5%)	6(37.5%)
Gastroenterologists	4(11.7%)	28(82.3%)	2(5.8%)
pediatricians	0	4(66.6%)	2(33.3%)
Surgeons	3(27.2%)	4(36.3%)	4(36.3%)

summary of demographics of the physicians responding to this survey study. There was relatively uniform distribution of responders across different specialties. Nearly two-thirds of the respondents (69%) reported working in an academic hospital-based practice. Nearly a third of the respondents (29.7%) were involved in taking care of ≥50 CD patients/year with 8.3% of physicians treating ≥200 CD patients/year. Among the respondents, only 16.7% were involved in care of pediatric CD patients in comparison to patients in the adult age group (Table 1). Majority of the respondents (58.5%) reported ordering ≥1 imaging exam/patient/year, while 27.4% and 14.2% of respondents' ordered imaging investigations once per year and < 1 in 5-year respectively (Table 1).

4.2. Practice pattern: imaging preferences

The respondents reported that the most commonly ordered imaging study in CD patients was CT/CT enterography (93.3%), followed by MR/MR enterography (58%), ultrasound (21%), radiographs (19.3%) and barium studies (18.5%). Imaging studies in CD patients were most commonly ordered for initial diagnosis (38.7%) followed by evaluation of acute complications (30.8%) and symptomatic exacerbation (26.4%). The most common provider expectation from imaging studies was for identification of complications such as fistula, abscess, stricture, and bowel obstruction (99.2%) followed by defining extent of disease (65.8%) and to determine the disease activity (58.3%) (Fig. 1). 40.4% of the respondents indicated that CT or MR enterography helped them in management in > 50% patients.

Responding to a question on preference among imaging studies, 41% (49/120) stated preference for CT, 40% (48/120) stated preference for MRI and 19% (23/120) did not have a specific preference (Table 2). The general reported reasons for preferring CT as imaging investigation of choice were - time efficiency and availability (60.87%), lower cost (21.7%), diagnostic accuracy (10.9%), comfort in reading the images themselves (4.34%), and issues with insurance coverage (2.17%). Among physicians reporting preference for MRI, the most common stated reasons for the choice were lack of radiation exposure (79.2%), diagnostic accuracy (18.8%) and specialist recommendation (2.1%).

The type of physician subspecialty practice setting and patient age group influenced the imaging preference in the choice between CT vs MRI (Tables 2 and 3). ER physicians responded with preference for CT and the most common reported reason was availability in ER and time efficiency. Internists and primary care physicians also preferred CT due to greater comfort and familiarity, institutional expertise and ability to read the scans themselves. MRI was a preferred modality for gastroenterologists and pediatricians and the primary reason for this preference was the concerns for radiation exposure. Surgeons surveyed had no predominant preference between CT and MRI.

Practitioners from non-teaching facilities had slightly higher preference for CT (CT: 42% vs MR: 27%), compared to teaching/academic hospitals (MR: 45% vs CT: 40%) ($p = 0.06$). MR was preferred by practitioners caring for pediatric (≤15 yr) patients (CT: n = 2; MR: n = 15; No preference: n = 3). There was a statistically significant ($p = 0.01$) preference of CT over MRI with increasing patient age,

Table 3
Imaging preference based on patient age, practice volume and practice type.

Physician characteristics		CT/CT enterography	MR/MR enterography	No preference	P value
Age groups	A. Practitioners serving pediatric (< 15 yr) patients	2(10%)	15(75%)	3(15%)	P = 0.015
	B. Physicians serving patients 16–30 yr old	26(41.2%)	27(42.8%)	10(15.8%)	
	C. Physicians serving patients 31–40 yr old	34(49.2%)	23(33.3%)	12(17.3%)	
	D. Physicians serving patients > 40 yrs	28(50.9%)	16(29%)	11(20%)	
Volume	A. Physicians taking care of < 50 patients per year	37(44.5%)	27(32.5%)	19(22.8%)	P = 0.02
	B. Physicians serving ≥50 patients per year	12(33.3%)	21(58.3%)	3(8.3%)	
Practice type	A. Non-teaching facilities(office based, non-teaching hospitals)	14(42.4%)	9(27.2%)	10(30.3%)	P = 0.067
	B. Teaching/research facilities(hospital teaching, academic research centers)	35(40.6%)	39(45.3%)	12(13.9%)	

Table 4
Studies ordered for the evaluation of different clinical indications

Indication	Plain radiography	Barium studies	Ultrasound	CT	MRI	Total respondents
Established Crohn's patient with new symptoms	9(9.1%)	4(4%)	6(6.1%)	73(73.7%)	39(39.4%)	99
Established Crohn's patient with acute presentation	20(17.5%)	2(1.8%)	8(7%)	100(87.7%)	27(23.7%)	114
Asymptomatic Crohn's patient undergoing surveillance	4(6.6%)	3(4.9%)	7(11.5%)	17(27.9%)	34(55.7%)	61
Evaluate for extra-intestinal disease manifestations	9(11.3%)	4(5%)	7(8.8%)	49(61.3%)	25(31.3%)	80
Disease activity	0	1(2.2%)	2(4.4%)	18(40%)	31(68.9%)	45

particularly for physicians serving patients > 40 yrs. (CT: n = 28; MR: n = 16; No preference: n = 11). The volume of the CD practice and indication for imaging influenced the imaging modality preferences (Table 4). CT was preferred by physicians taking care of < 50 patients/year (CT: n = 37; MR: n = 27; no preference: n = 19) and MR was preferred by physicians serving ≥50 patients/year (CT: n = 12; MR: n = 21; no preference: n = 3) (p = 0.02) (Table 3). There was no difference in imaging modality preference based on the years of experience of the provider. CT was the preferred modality for established CD with new symptoms (73.7% for CT), acute presentation (87.7% for CT) and evaluation of extra-intestinal manifestations (61.3% for CT). MRI was reported to be a preferred modality for evaluation of disease activity (68.9%) and surveillance for asymptomatic patients (55.7%) (Table 4).

4.3. Trends in imaging preference

In terms of trends in choice of imaging preference over the past 5 years, 46.5% of respondents reported using MRI more as compared to 33.3% reporting increased used of CT (20.2% reported no change in imaging preference). The increasing use of CT was reported to be more for initial diagnosis more than the follow up (Initial- 28.9%; Follow up-15.8%; Both- 55.2%) while the increasing use of MR (Initial 3.9%; Follow up 29.4% 15; both 66.6%) was reported to be more often for both follow up imaging and initial diagnosis.

4.4. Patient preference

Most physicians reported that majority of patients did not have a preference between the two modalities, however twice the number of patients preferred MR over CT (CT-13%: n = 15/115; MR-29.6%: n = 34/115; No preference: 57.4%: n = 66/115). The main factor for preference of MRI by patients was concerns about harmful effects of radiation from CT (97%, 33/34). Among patients reportedly favoring CT, the reasons attributed for the choice included comfort (8/15), scan time (5/15), claustrophobia associated with MRI (1/15) and cost (1/15).

5. Discussion

In our survey-based study, we intended to understand the imaging practice patterns of providers involved in care of CD. The survey results show that physician respondents continue to prefer CT/CT Enterography as the most frequent imaging study in CD patients overall. In asymptomatic patients, MR is most preferred imaging modality for disease surveillance, while CT is still the most preferred imaging modality for evaluation of patients with acute exacerbation, those with new symptoms and extra intestinal manifestations. Despite CT being the predominant imaging modality for evaluation of CD there is a growing preference for utilization of MRI during the past 5 years as reported by 46.5% of our respondents. The survey results pointed to large practice volume, younger patient age and sub-specialty expertise as the main factors contributing to growing use of MR. Lack of radiation exposure and higher diagnostic accuracy were reported to be influencing the preference of MRI over CT.

Our intent in this survey was also to understand the trends in imaging utilization by providers and determine the imaging preferences of patients. Though patients were not directly surveyed in this study, nearly two-third of the physicians reported that patients do not prefer any particular imaging modality. This is important to note that despite the public awareness about the radiation risks from CT, patients to a large extent rely on the treating physicians to make those decisions for

them [13,14]. Among the patients who did have a preference, the physicians reported that nearly twice of them preferred MRI to CT. The most common reason for such a preference was reported to be concerns of radiation exposure from CT.

Medical use of radiation has increased significantly over the past few decades and CT has emerged as the dominant contributor to medical radiation exposure. CT accounts for approximately 49% of all the medical radiation dose to the United states population [15–18]. There has been growing concerns over the increasing radiation burden from CT in CD population and its potential harmful effects as these patients might require multiple imaging exams over the course of their life time [19–27]. According to a recent meta-analysis, up to 10% of CD patients received a cumulative radiation exposure ≥50 mSv. A cumulative radiation exposure of ≥50 mSv is considered a threshold for nonzero cancer risk resulting from radiation exposure [28]. Following the introduction of the targeted biologic agents such TNF-alpha inhibitors there has been increased expectations from the imaging studies for determination of disease activity and response assessment [2]. Although traditionally the accuracy CTE and MRE has been reported to be comparable [4], the emerging MR technology has led to development of new applications such as diffusion-weighted imaging (DWI), ultra small super paramagnetic iron oxide- (USPIO-) enhanced MRI, and PET-MR. These techniques are potentially useful for detecting treatment response, treatment resistance and occult disease activity. These techniques can also be used for differentiating fibrotic from inflammatory strictures [2,7,9,29,30]. MR technology has been reported to be highly sensitive for the new therapeutic end points such as mucosal healing [2,31]. The concerns of radiation risk from CT and the emergence of newer MR techniques might have affected the ordering practices of imaging studies in CD patients. At several institutions, MRE has replaced CTE as the primary cross-sectional imaging modality for both pediatric and adult patients with CD [4,21,32,33]. Our survey also shows that the physicians working in an academic setting, large practice and with gastroenterology expertise preferred MRI. The reasons behind such preference could be the available radiology expertise on MRE in the high volume academic setting [2,7,9,29,30,33]. Another factor could be that as the academic centers generally act as tertiary/quaternary referral care centers and the presenting patients might have severe/difficult to treat illness requiring frequent imaging; and hence concerns for radiation might be higher in this setting.

In our study, we saw disparity in the choice of imaging modality based on the practice volume, type of provider specialty and age of CD patients and CT was still preferred. The factors contributing to preference for CT among CD providers included cost issues, radiologist familiarity and ease in reading the imaging studies themselves. Another important factor for preferring CT was its availability in an emergency setting particularly for ER physicians. Additionally, as the patients presenting to the ER are often in poor clinical condition, they are likely to be non-compliant to various instructions during the MR scan acquisition. This renders generation of diagnostic quality MR studies in acutely ill patients challenging. Other factors such as lack of round-the-clock MR technical support and limited equipment availability might also be responsible for CT preference in the ER. Another limitation to the use of MR in emergency departments might be the difficulty in getting insurance coverage for the MRI studies as reported by one of our respondents [33].

This study has few limitations. Firstly, due to study design of a survey-based questionnaire, the responses of the physicians represented subjective perception of their practice and did not include any objective measurements of the actual practice and patients were not directly interviewed for their preferences. Secondly, the low response rate and relatively low response from physicians from non-academic facilities could possibly bias the results. Another potential limitation is response bias based on the practice pattern of the responder. Providers particularly those with subspecialty GI expertise and large CD practice volume might have been more likely to respond or willing to respond to the survey, which could potentially lead to overestimation of MR preference.

6. Conclusion

Survey results from this study suggest that CT/CT enterography is still the most frequently used imaging study in patients with CD. This is especially true for patients with acute indications such as acute exacerbation, evaluation of Crohn's patient with new symptoms, and evaluation of extra intestinal manifestations. There is an increasing trend for ordering MR/MR enterography, which is primarily preferred for disease activity and surveillance in asymptomatic patients. Large practice volume, younger patient age and GI sub-specialty expertise are associated with growing use of MR. Patient related factors such as fear of radiation exposure are also responsible for an increased use of MR/MRE in these patients.

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Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Appendix A

Questionnaire

1. Which of the following best describes you?

1) Physician 2) Physician assistant 3) Nurse practitioner

4) Resident 5) Fellow 6) others (please specify)

2. Please indicate your medical specialty.

1) Ambulatory/Primary Care 2) Emergency Medicine 3) Gastroenterology

4) Internal Medicine 5) Pediatrics 6) Gastrointestinal surgeon

3. Please indicate your work setting.

1) Office Based 2) Hospital–Teaching 3) Hospital—Nonteaching

4) Academic Research 5) Corporate—Private Industry 6) Home Health Care

7) Other (please specify)

4. For how long have you been involved in the care of Crohn's patients?

1) < 5 years 2) 6-10 years 3) 11-20 years 4) > 20 years

5. What is the approximate age (in years) group of the Crohn's patient population in your practice (Check all that applies)?

1) ≤15 2) 16-30 3) 31-40 4) >40

6. How many patients with the diagnosis of Crohn's disease do you encounter each year?

1) < 10 2) 11-50 3) 51-100 4) 101-200 5) > 200

7. On an average how often do these patients undergo Imaging during follow up?

1) Less than once in 5 year 2) once in 5 years 3) once every year 4) More than once a year

8. Please rank the following imaging indications, in order of incidence in your practice (1 most frequent and 6 least frequent).

1) Initial Diagnosis 2) Surveillance on treatment

3) Symptomatic exacerbation 4) Monitor Treatment Response

5) Surgical planning 6) Evaluation of acute complications

9. What are your expectations from imaging studies for clinical management of Crohn's patients? Check all that apply.

1) Determine disease activity

2) Define extent of disease

3) Identify complications such as fistula, abscess, stricture, bowel obstruction

4) Identify new sites of disease or cancer

5) Monitor response to medical, surgical or interventional radiology therapy

6) Others/please specify

10. What are the imaging studies that you order in Crohn's patients? Check all that apply

1) Plain radiography 2) Barium studies 3) Ultrasound 4) CT 5) MRI

11. In what percentage of your patients with Crohn's disease does CT or MR Enterography help you in management?

1) Less than 10% of patients 2) 10-25% of patients 3) 25-50% of patients

4) 50-75% of patients 5) more than 75% of patients

12. What imaging study do you typically order for the following indications?

A. For established Crohn's patient with new symptoms

☐ Plain radiography ☐ Barium studies ☐Ultrasound ☐CT ☐ MRI

B. For established Crohn's patient with acute presentation

☐ Plain radiography ☐ Barium studies ☐Ultrasound ☐CT ☐ MRI

C. For asymptomatic Crohn's patient undergoing surveillance

☐ Plain radiography ☐ Barium studies ☐Ultrasound ☐CT ☐ MRI

D. To evaluate for extraintestinal disease manifestations

☐ Plain radiography ☐ Barium studies ☐Ultrasound ☐CT ☐ MRI

E. To evaluate for disease activity

☐ Plain radiography ☐ Barium studies ☐Ultrasound ☐CT ☐ MRI

13. Between CT & MR Enterography, which modality do you prefer to order?

1) CT/CT Enterography 2) MR /MR Enterography 3) No preference

14. What is the reason for the response selected in question 13?

1) Diagnostic accuracy 2) radiation exposure 3) Cost

4) Patient preference 5) Not applicable 6) Others/please specify

15. What has been your practice's trend in ordering cross-sectional imaging over the past 5 years?

1) MR preferred more often 2) CT preferred more often 3) no change in CT or MRI

16. What part of your practice does this change applies to?

1) Initial diagnostic work up 2) Follow up Imaging 3) Both 4) Not applicable

17. Do patients have a preference for a particular imaging study?

1) CT 2) MRI 3) No Preference

18. What do you think is most likely reason for patient preference for a particular?

Imaging modality?

1) Oral preparation 2) radiation exposure 3) Cost

4) Exam duration 5) Patient comfort 6) Others/please specify

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