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Ecco Guideline/Consensus Paper

ECCO-ESGAR-ESP-IBUS Guideline on Diagnostics and Monitoring of Patients with Inflammatory Bowel Disease: Part 2

Part 2: IBD scores and general principles and technical aspects

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1. Introduction

Inflammatory bowel disease (IBD), which includes Crohn's disease (CD) and ulcerative colitis (UC), requires meticulous diagnostic and monitoring protocols to optimize patient outcomes. This document synthesizes key advancements and recommendations for clinical indices, endoscopic scoring, imaging, histological assessment, and tools for evaluating IBD disability. Emphasizing validated, reproducible methods aligns with the ongoing evolution of precision medicine in IBD care, including training. The methodology of the guidelines update process is described in part 1 [ref].

2. Scoring systems for inflammatory bowel disease

Recommendation 38: We suggest using clinical indices in patients with IBD to assess clinical disease activity [EL5]. Agreement 100%

Remission of disease activity currently represents an important therapeutic goal in managing patients with UC and CD. The diagnostic and prognostic role and value of endoscopy, which remains the reference standard for assessing disease activity, have been widely reported.[1–10] We suggest using clinical indices in patients with IBD to assess clinical disease activity at every visit. Clinical indices are valuable tools for evaluating UC or CD activity in trials and clinical practice; current scoring systems, along with their limitations and strengths, are presented in Tables 1 and 2. As no ideal clinical index exists, validated clinical indices may represent the preferable strategy.

Recommendation 39: We recommend routinely using an endoscopic index in patients with IBD to standardize reporting of the grade of disease activity [EL5]. Agreement 100%

Numerous endoscopic scoring systems have been developed in recent years and are increasingly used in clinical practice to guide treatment decisions in IBD patients. These systems assess the endoscopic response to therapy and also predict histological outcomes, which are gaining recognition as potential therapeutic goals, particularly in UC.[22–24] The Mayo Endoscopic Subscore (MES)—a subscore in the full Mayo score,[12] the UC endoscopic index of severity (UCEIS),[25] and the UC colonoscopic index of severity (UCCIS)[26] are well-established and widely accepted scoring systems for assessing endoscopic activity in UC.[27–29] More recently, the Paddington international virtual chromoendoscopy score [PICaSSO][30–33] has been developed. This was initially validated using the iSCAN platforms[31–34] and then accurately reproduced across various virtual electronic chromoendoscopy platforms, such as Narrow Band Imaging and Linked Color Imaging or Blue Light Imaging.[30] These schemes record endoscopic disease severity but do not consider anatomical extent. The modified MES (MMES)[35] and the pan-colonic modified Mayo score (PanMayo)[36,37] combine the assessment of UC disease extent with an assessment of severity. Table 3 summarizes the limitations and strengths of UC endoscopic scoring systems.

The pouchitis disease activity index (PDAI)[14] and endoscopic pouch score (EPS)[44] can provide a standard definition of pouchitis for evaluating the J pouch in UC.

For CD, the CD endoscopic index of severity (CDEIS)[45] and the simple endoscopic score for CD (SES-CD)[46] are validated and reproducible scoring systems for measuring luminal endoscopic activity.[47,48] Furthermore, a modified multiplier of the SES-CD (MM-SES-CD) score has been recently proposed.[49,50] This score considers each parameter's prognostic value for achieving endoscopic remission while on active therapy and could be used to predict the achievement of endoscopic remission and assess treatment efficacy.[51]

The Rutgeerts score[52] remains a widely used tool in clinical practice for assessing postoperative recurrence in CD and guiding treatment decisions.[53] A modified Rutgeerts score,

Table 1. Ulcerative colitis indices of activity.

Index	Strengths	Limitations	Validated
SCCAI[11]	- Validated, purely clinical index - Patients can complete it independently - The only score to include urgency, incontinence, and night bowel movements	- Some patient-relevant UC symptoms are not in the index	Validated
Full Mayo[12]	-Composite clinical, endoscopic, quality of life, and global assessment index -Widely used in clinical trials -Full and partial Mayo scores are available	- Not evaluated against an independent disease activity measure - Patient perception of clinically meaningful change is unknown - Not validated	Not Validated
UCDAI[13]	-Easy to use	-Less reliable with severe clinical symptoms -Not validated	Not Validated*
PDAI[14]	-Sufficient to select appropriate treatment plans -Modified version mPDAI consists of clinical symptoms and endoscopic findings only[15]	-Active pouchitis is arbitrarily defined as a score ≥ 7 and remission as a score < 7 -Not validated	Not Validated
Seo[16]	-Derived using multivariable regression analysis of prospective data on clinical, laboratory, and sigmoidoscopy variables	-Not validated	Not Validated

Abbreviations: PDAI = Pouchitis disease activity index, SCCAI = Simple clinical colitis activity index, UCDAI = Ulcerative colitis disease activity index.
*Some evidence of validity but minimal clinically important differences not established.
See Appendix 1 for more details.

Table 2. Crohn's disease indices of activity.

Index	Strengths	Limitations	Validation
CDAI[17]	-Assesses disease activity over 1 week -The most frequently used index for clinical trials	-Subjective variables [pain, diarrhoea] -Interobserver variability -Subjective perceptions ['general wellbeing' and 'intensity of abdominal pain' items] are given high scoring weights -7 days prior patient diary is needed -Less accurate in fistulizing and stenosing disease -Less accurate when extensive ileo-colonic resections or stoma is present - Poor correlation with objective disease activity - Cumbersome to calculate - Detects minor disease activity changes less accurately - Does not reflect long-term complications or disease progression	Validated*
HBI[18]	-24 hour diary -Easy to calculate, simpler, and quicker to use than CDAI[17] -Objective variables, more practical for routine clinical use -Highly correlated with CDAI [r = 0.93]	-Variability due to calculation based on a single day -Less comprehensive than CDAI[19] -May underestimate disease activity compared with CDAI in some cases[20]	Not Validated
PDAI[21] **for perianal CD**	-Quantifies disease severity -Acceptable measurement variation -Can detect important changes in perianal activity -Easy to administer	-Was designed to assess the response to medical management and the overall well-being of the patient, excluding any anatomical or surgical considerations	Validated**

Abbreviations: CDAI = Crohn's disease activity index, HBI = Harvey-Bradshaw index, PDAI = Perianal disease activity index.
*Results from the CDAI correlate with those from the HBI; using the HBI may permit simpler CD activity assessment in long-term clinical trials and facilitate standardised disease activity measurements and cross-centre comparisons. However, the validation of the index has varied. A key criticism of the CDAI is that it does not incorporate a subjective assessment of quality of life, endoscopic factors, or systemic features, such as fatigue, into its calculation.
**The PDAI demonstrated content validity, construct validity, and responsiveness, but criterion validity or reliability were not assessed.
See Appendix 2 for more details.

which includes i2a for lesions confined to the ileocolonic anastomosis and i2b for larger lesions in the neo-terminal ileum (with or without anastomotic lesions), attempts to address the heterogeneity of the original Rutgeerts score.[54] Two recent additional indices are the REMIND score,[55] which evaluates anastomotic and ileal lesions separately, and the POCER index,[53] which includes new scoring criteria for the anastomosis, such as ulcer depth and circumferential ulcer extent. Table 4 summarizes the strengths and limitations of CD endoscopic scoring systems.

Table 3. Ulcerative colitis endoscopic scoring systems.

Index	Strengths	Limitations	Validation
MES[12]	-Easy to use -Widely used in clinical trials	-Based on WLE -Does not reflect disease extension -Overlap between remission and mild activity[38,39]	Partially validated
MMES[35,40]	-Easy to use -Combines MES disease severity with extent	-No endoscopic remission definition -No thresholds for mild, moderate, or severe disease -Not validated	Not validated
UCEIS[25]	-Easy to use -Closely correlated with clinical activity and histology[41]	-No endoscopic remission definition -No thresholds for mild, moderate, or severe disease -No definition of superficial vs deep ulcers -Does not reflect disease extension[42,43]	Validated
UCCIS	-Easy to use -Good to excellent interobserver agreement	-No endoscopic remission definition -No thresholds for mild, moderate, or severe disease -Developed in a single center	Partially validated
PICaSSO[30–33]	-Developed with CE -Strong correlation with histology -Reproducible with all endoscopic platforms	-Requires endoscopy experience -No thresholds for mild, moderate, or severe disease	Validated
PanMayo[36,37]	-Includes disease extent -Strong correlation with other endoscopic indices	-Reproducibility of endoscopic scores suboptimal -Use of the IC makes the calculation of PanMayo Score slightly complicated - Not validated	Not validated

Abbreviations: CE = capsule endoscopy, IC = Inflammatory constant, MES = Mayo Endoscopic Subscore, MH = mucosal healing, MMES = Modified MES, UCCIS = Ulcerative colitis colonoscopic index of severity, UCEIS = Ulcerative colitis endoscopic index of severity, PanMayo = Pan-colonic modified Mayo score, PICaSSO = Paddington international virtual chromoendoscopy score, WLE = White-light endoscopy.
See Appendix 3 for more details.

Recommendation 40: We suggest routinely using validated cross-sectional imaging indices to assess and monitor disease activity and therapeutic response in patients with IBD [EL5]. Agreement 89%

Intestinal ultrasound (IUS) accurately and reliably detects changes in bowel-wall thickness (BWT), bowel-wall vascularization, and mesenteric changes both at baseline and in response to therapy in patients with CD[61–69] and UC.[70–73] Changes in IUS parameters strongly predicted endoscopic disease severity and demonstrated good intra- and inter-observer reliability in several studies. In all studies, the two most significant parameters of inflammatory activity on IUS were BWT and bowel-wall vascularization (hyperemia) as measured by color Doppler signal (CDS).

Seven IUS scores are currently described for CD (Table 5). All scores incorporate BWT and CDS. The international bowel ultrasound segmental activity score (IBUS-SAS),[74] bowel ultrasound severity score (BUSS),[76] and simplified ultrasound score for Crohn's disease (SUS-CD)[75] are the most strongly correlated with SES-CD compared with other scoring systems; however, they are also the most commonly studied.[66] IBUS-SAS correlates more strongly with clinical scores and serum biomarkers.[69] Both BUSS and SUS-CD have moderate sensitivity and specificity in predicting histological activity.[64]

The three predominant IUS scores used in UC are the IBUS-SAS, the Milan ultrasound criteria (MUC),[77,78] and the ulcerative colitis intestinal ultrasound score [UC-IUS][71] (Table 6). The MUC includes BWT and CDS, and UC-IUS also incorporates mesenteric inflammatory fat. MUC and IBUS-SAS have been validated; the UC-IUS has not been validated. Responsiveness to therapy has also not been assessed. All three showed strong correlations with MES.[70–73] MUC is an independent predictor of MES and predicts long-term endoscopic response, and risk of colectomy.[70,80]

Although these scoring systems facilitate the standardization of IUS findings, their calculation may be time-consuming. The integration of automated calculation tools could further support the implementation of these scores in routine clinical practice. Moreover, while the MUC score differentiates between MES 0–1 and MES 2–3, additional dedicated studies are needed to evaluate the accuracy of scoring indices in distinguishing mild disease from moderate-to-severe disease in both UC and CD. Last, data on rectal assessment is limited, and there is no universally adopted definition of rectal transmural remission, which is a paramount research priority.

In patients with CD, magnetic resonance enterography (MRE) also accurately and reliably detects intestinal wall and mesenteric changes reflecting disease activity at baseline and in response to therapy. Different scoring systems, including the Magnetic Resonance Index of Activity (MaRIA), simplified MaRIA, London score, and Clermont score, have been developed and validated against a range of reference standards for assessing activity in CD (Table 7).[90,105–107] Regression models have identified the descriptors constituting the indices that serve as independent predictors of luminal activity and severity in CD. Despite differences in their details, the scores include similar components. Recent studies demonstrate moderate-to-substantial reproducibility among expert readers for magnetic resonance imaging (MRI)-based scoring systems with intraclass correlation coefficients and kappa values ranging from 0.67 to 0.71 for established indices, and interrater agreement of 96% for simplified MaRIA and 79.3% for MaRIA scoring methods.[85,93,100] Several studies indicate that these indices correlate well with endoscopic indices of severity (eg, SES-CD or CDEIS)[84,87,90,94,96,102,108,109] or histology indices[64,82] and help assess response to medical treatment.[89,90]

Table 4. Crohn's disease endoscopic scoring systems.

Index	Strengths	Limitations	Validation
CDEIS[45]	-Highly correlated to the endoscopist's lesion severity evaluation -High reproducibility level -Reliable	-Not practical in daily practice -Requires precise and specific data recording and prior training -Underestimates disease severity when only one of five segments is involved, especially the ileum	Validated
SES-CD[46]	-Reliable	-Equal importance and weight across all disease segments - Less sensitivity for mild disease or subtle changes -Scoring of non-passable stenosis compared with those with passable stenosis[56] - Limited assessment of the small bowel -Debate on the inclusion of aphthoid ulceration in the ulcerated surface area -Debate on scoring anal lesions as part of the rectum - Subjectivity and inter-observer variability	Partially validated
MM-SES-CD[49–51]	-More accurate than the original SES-CD score for predicting endoscopic remission -Increased weighting is assigned based on baseline ulcer size, extent of ulceration, and presence of non-passable strictures, disease localization	-Lack of definition for endoscopic remission -Cumbersome to calculate in routine clinical practice	Partially validated
SEMA-CD[57–59]	-Strong correlation with SES-CD -Easier to use than SES-CD -Reliable, reproducible, sensitive to change in both pediatric and adult patients	-Not validated	Not validated
Rutgeerts score[52]	-Associated with clinical recurrence -Fair reliability -Easy to use in clinical practice	-Moderate reliability, especially < i2 vs ≥ i2 -Large variability -Developed to evaluate ileocolonic end-to-end anastomosis -Fails to distinguish between mild anastomotic lesions and multiple isolated neoterminal ileum lesions -Colonic disease recurrence is not captured[56,60] -Not validated	Not validated
Modified Rutgeerts score[54]	-Differentiation between lesions confined to the ileocolonic anastomosis [including anastomotic stenosis] and neoterminal ileum	-Originally developed for evaluation of an ileocolonic end-to-end anastomosis -Colonic disease recurrence is not captured -Not validated	Not validated
POCER Index[53]	-Easy to use -High reproducibility	-Not predictive of severe endoscopic recurrence [Rutgeerts score ≥ i3] or clinical recurrence at 18 months -Not validated	Not validated
REMIND score[55]	-Good inter-rater reliability -Separates anastomotic lesions [sub-score A] from ileal lesions [sub-score I] with anastomotic lesions graded based on their circumferential extent and ileal lesions	-Not validated, requires further validation in independent cohorts -Absence of thresholds for endoscopic post-operative recurrence	Not validated

Abbreviations: CDEIS = Crohn's disease endoscopic index of severity, MM-SES-CD = Modified multiplier of the SES-CD, SES-CD = Simple endoscopic score for Crohn's disease, SEMA-CD = Simplified endoscopic mucosal assessment for Crohn's Disease.
See Appendix 4 for more details.

Overall, the aforementioned observations support the implementation of MRE scoring systems in clinical practice to provide more objective and standardized assessments of MRE findings of active disease, facilitate grading of severity, and measure response to therapy.[81,87,91,95] The MaRIA score is the best-characterized index among MRE scoring systems. The MaRIA, simplified MaRIA, and Clermont scores offer higher disease severity stratification than the London index. However, the applicability of the Clermont index, specifically the quantification of apparent diffusion coefficient (ADC) in multicentric trials remains to be determined.

The Sailer index was developed using an expert opinion approach to assess the likelihood of postoperative recurrence at the anastomotic site.[110] Further research is warranted in this area, particularly regarding the use of MRE.

Definitions of transmural response and remission vary widely in the literature, complicating the establishment of standardized definitions. However, these endpoints are important due to their association with improved clinical

Table 5. Intestinal ultrasound indices for Crohn's disease

Scoring Index	Formula	BWT	CDS	BWS	i-fat	Strengths	Limitations	Evidence	Validation
IBUS-SAS[61–63,69,74]	Scored 0–100 = 4*BWT + 15*i-fat + 7*CDS + 4*BWS	Normal ≤ 3 mm Active > 3 mm	0 = absent 1 = short signals 2 = long signals inside bowel 3 = long signals inside and outside bowel	0 = normal 1 = uncertain 2 = focal ≤ 3 cm 3 = extensive > 3 cm	0 = absent 1 = uncertain 2 = present	Incorporates BWT, BWS, CDS, and i-fat Most investigated Strong predictor of endoscopic remission Most responsive score	More granular [onerous to calculate]	Multiple studies with reproducible sensitivity, specificity, and accuracy Strong intra- and inter-rater reliability	Validated in multiple studies and shows good correlation with endoscopic scores. IBUS-SAS demonstrates high sensitivity and specificity for detecting endoscopic activity in CD
SUS-CD[61,63,69,75]	Scored 0–5 = BWT + CDS	0 = < 3 mm 1 = 3–4.9 mm 2 = 5–7.9 mm 3 = ≥ 8 mm	0 = absent or single vessels 1 = 2–5 vessels/cm^2 2 = > 5 vessels/cm^2	---	----	Simple calculation Strong predictor of endoscopic remission Correlated with histologic remission	Less specific than IBUS-SAS	Strong correlation with SES-CD Strong intra and inter-rater reliability	Validated and shows good correlation with endoscopic scores like SES-CD and has demonstrated high accuracy in identifying endoscopic activity.
BUSS[62,76]	= 0.75* BWT + 1.65*CDS	Normal ≤ 3 mm Active > 3 mm	0 = absent 1 = present	---	---	Simple calculation Strong predictor of endoscopic remission Correlated with histologic remission	Less specific than IBUS-SAS Less responsive	Strong correlation with SES-CD Strong intra and inter-rater reliability	Validated and shows good correlation with endoscopic activity and has demonstrated accuracy in assessing response to therapy in CD
Simple-US[61]	= BWT + CDS	Normal ≤ 3 mm Active > 3 mm	0 = absent 1 = 1–2 points/cm^2 2 = 3–5 points/cm^2 3 = > 5 points and vessels outside the intestinal wall	---	---	Simple calculation	Less specific than IBUS-SAS Fewer studies for comparison	Strong correlation with endoscopic activity	Not validated

Table 5. Continued

Scoring Index	Formula	BWT	CDS	BWS	i-fat	Strengths	Limitations	Evidence	Validation
UCS[65]	Scored= S1 [score for symmetry] +S2 [score for the echogenicity of peri-bowel fat] +S3 [Limberg type] +S4 [score for bowel-wall layer structure] +S5 [score for the echogenicity of the bowel walls] +S6 [score for BWT]	S6 = rounding value of the BWT [mm]. 3 mm = 3 pts If 3.6 mm = 4 pts	S3 = 0 if Limberg type 0, I, or II S3 = 1 if Limberg type III or IV	S1 = 0 point if the anterior and posterior bowel-wall layers are symmetrical S1 = 1 point if asymmetrical S4 = 0 points if normal echostratification S4 = 1 point if the bowel-wall layers are less clear but the inside and outside layers can be distinguished S4 = 2 points if all layers are unclear S5 = 0 points if the thickness of the hyperechoic submucosa is smaller than the thickness of the hypoechoic muscularis mucosa, or all layers are hypoechoic S5 = 1 point if the thickness of the hyperechoic submucosa is similar to the thickness of the hypoechoic muscularis mucosa S5 = 2 points if the thickness of the submucosa is larger than the thickness of the muscularis mucosa or all layers are hyperechoic	S2 = 0 point if absent S2 = 1 point if present	Strong correlation with SES-CD	Includes several subjective bowel-wall layer characteristics Only one assessor and mannitol administration Not practical	Strong correlation with endoscopic activity	Not validated

Table 5. Continued

Scoring Index	Formula	BWT	CDS	BWS	i-fat	Strengths	Limitations	Evidence	Validation
US-LI[68]	See reference [complex calculation]					Correlates with MRI	Currently a Delphi consensus on the US-LI as many of the MR-LI characteristics are not well translated to US, thus US-LI is not recommended for standard assessment	High concordance between US-LI and MR-LI	Not validated
SUAS-CD[67]	(0.957*BWT) + (0.859*MLS)	BWT in mm	Modified Limberg scale: absent = 0 1–2 points/cm^2 = 1 3–5 points/cm^2 = 2 > 5 points and vessels outside the intestinal wall are detected = 3	---	---	Simple calculation	Not validated in any other prospective studies	Correlated with endoscopic activity	Not validated

Abbreviations: BUSS = Bowel ultrasound score, BWT = Bowel-wall thickness, BWS = Bowel-wall stratification, CDS = Colour Doppler signal, IBUS-SAS, International bowel ultrasound segmental activity score, MRI = Magnetic resonance imaging, MR-LI = Magnetic Resonance Lémann Index, SES-CD = Simple endoscopic score for Crohn's disease, SUS-CD = Simple ultrasound score for Crohn's disease, Simple-US = Simple ultrasound, SUAS-CD = Simple ultrasonographic activity score for Crohn's disease, UCS = Ultrasound Crohn's score, US-LI = Ultrasound Lémann index.

Table 6. Intestinal ultrasound indices for ulcerative colitis.

Scoring Index	Formula	BWT	CDS	BWS	i-FAT	Strengths	Limitations	Evidence	Validation
IBUS-SAS[72]	Scored 0–100 =4*BWT + 15*i-fat + 7*CDS + 4*BWS	Normal ≤ 3 mm Active > 3 mm	0 = absent 1 = short signals 2 = long signals inside bowel 3 = long signals inside and outside bowel	0 = normal 1 = uncertain 2 = focal ≤ 3 cm 3 = extensive > 3 cm	0 = absent 1 = uncertain 2 = present	Multiple studies highlighting reproducible sensitivity, specificity, and accuracy	More granular [onerous to calculate]	Strong correlation with endoscopic activity, both MES and UCEIS Optimal cutoff for predicting moderate endoscopic activity was higher using UCEIS	Not validated
MUC[70,73,77,78]	=1.4*BWT + 2x BWF	BWT = mm	1 = present 0 = absent	---	---	Multiple studies with reproducible results Highly correlated with endoscopic activity	Only includes two parameters	MUC < 6.2 predicted endoscopic improvement MUC at week 12 was an independent predictor for MES < 1 and MES = 0 MUC < 6.2 at week 12 predicted long-term endoscopic response[20] MUC > 6.2 for predicted endoscopic activity[21]	Validated using endoscopy as a reference standard
UC-IUS[79]	Score 0-7 =BWT + CDS + i-fat	>2 mm = 1 pt >3 mm = 3 pt >4 mm = 3 pt	Spots = 1 pt Stretches = 2 pt		Present = 1	Strong correlation with MES	More onerous to calculate Not validated prospectively	Strong correlation with MES and UCEIS	Validated using endoscopy, showing strong correlation with the Mayo endoscopic subscore

Abbreviations: BWF = Bowel wall flow, BWT = Bowel-wall thickness, BWS = Bowel-wall stratification, CDS = Colour Doppler signal, IBUS-SAS = International bowel ultrasound segmental activity score, MES = Mayo endoscopic score, MUC = Milan ultrasound criteria, UCEIS = Ulcerative colitis endoscopic index of severity, UC-IUS = Ulcerative colitis intestinal ultrasound score.

Table 7. Magnetic resonance enterography scoring systems.

Scoring index	Formula	Strengths	Limitations	Evidence supporting its use in clinical research	Validation
MaRIA[81–97]	1.5 × WT + 0.02 × RCE + 5 × edema + 10 × ulcer	-Accurate for small and colonic segments -Allows grading by severity -Can assess treatment response -Most investigated in research	-Time-consuming to calculate -Requires gadolinium	-Reproducibility and specificity in multicentre and multireader settings with a range of reference standards -Good correlation with a range of reference standards -Can be used to monitor CD activity in response to treatment -Therapeutic target associated with clinical outcomes	Validated
sMaRIA[64,90,94,98–104]	(1 × WT > 3 mm) + (1 × wall edema) + (1 × fat stranding) + (2 × ulcers)	-Can be applied to small- and large-bowel segments -Can grade by severity -Good responsiveness to treatment change -Rapid to derive -Does not require gadolinium -Practical in clinical practice	-Reproducibility needs evaluating	-Specificity with a range of reference standards -Good correlation with a range of reference standards -Responsive to treatment	Validated
London[64,85,89,93]	1.79 + 1.34 × mural thickness + 0.94 × mural T2 score	-Rapid to derive -Does not require gadolinium -Can assess treatment response	-Only applicable to small-bowel segments -Does not allow grading by severity	-Reproducibility and specificity in multicentre and multireader settings with a range of reference standards -Responsive to treatment	Not validated
Clermont[83,85,88,94,97]	−1.321 × ADC (mm^2/s) + 1.646 × WT + 8.306 × ulcers + 5.613 × edema + 5.039	-Accurate for small- and large-bowel segments -Allows grading by severity -Can assess treatment response	-Time-consuming to calculate -Requires diffusion-weighted sequences -Unknown applicability in multicentric clinical trials	-Good correlation with endoscopy and other magnetic resonance indexes -Use as therapeutic target associated with clinical outcomes -Can monitor CD activity	Validated

Abbreviations: ADC = Apparent diffusion coefficient, CD = Crohn's disease, MaRIA = Magnetic resonance index of activity, sMaRIA = Simplified magnetic resonance index of activity, RCE = Relative Contrast Enhancement, WT = wall thickness.

outcomes.[81,87,91] A study of 89 CD patients revealed that a segmental MaRIA score ≥ 11 after 46 weeks of treatment with biological drugs was linked to an increased risk of surgery (odds ratio [OR]: 11.6; 95% confidence interval [CI]: 1.5–92.4) within 2 years.[111] A MaRIA score < 11 was associated with a lower risk of clinical (hazard ratio [HR]: 0.24; $P = .001$) and biochemical relapse (HR: 0.47; $P = .003$), while a score ≥ 11 indicated a higher risk of hospitalization (HR: 3.59; $P < .001$) and surgery (HR: 5.89; $P = .006$).[96] Additionally, a MaRIA score ≥ 10.6 after induction predicted persistent severe inflammatory lesions in the terminal ileum after 1 year of treatment with anti-TNF agents (OR: 0.89; $P = .042$).[95] Early transmural response, defined as a 25% decrease in Clermont or MaRIA scores, was also linked to corticosteroid-free remission after 1 year of treatment with anti-TNF agents.[97] The lack of universally accepted definitions for transmural response and remission using cross-sectional techniques remains a significant research priority.

Recommendation 41: We suggest using a validated histological scoring system for assessing UC [EL5]. Agreement 90%

Previously, treatment for UC and CD aimed primarily to achieve clinical and endoscopic remission. However, up to 40% of patients reaching these milestones still exhibit ongoing histological activity. Numerous studies highlight the correlation between histological activity and clinical course and outcomes of UC.[112–114] Recent data confirm that achieving histological remission, or absence of microscopic activity, is superior to endoscopic and clinical remission in predicting clinical outcome.[115] Histological remission predicts a better outcome in patients with UC, as this correlates with a reduced rate of clinical relapse, lower corticosteroid use, lower hospitalization and colectomy rates, and a lower risk of developing IBD-related neoplasia.[41,116–119] Therefore, achieving histological remission, also defined as the absence of mucosal inflammation, has become a suitable and realistic endpoint in UC in clinical trials. Limitations to its adoption as a target or endpoint of treatment include the requirement for mucosal biopsy at every endoscopic procedure and the need for more aggressive therapy if all patients are to reach this endpoint. Histological activity in IBD is defined by the presence of neutrophils in the mucosa (with some variation between scoring systems on the exact location and number of neutrophils), whereas histological remission is defined variably as minimal residual microscopic disease or, according to the strongest definition proposed by ECCO, as normalization of mucosal histology[120,121] and absence of neutrophils. Using validated scoring schemes is necessary to standardize the evaluation of histological mucosal lesions, to assess the degree of mucosal

inflammation and activity, to support clinical decision-making, to determine the response to specific treatments, and to facilitate research by ensuring consistent and objective assessments.

There are several histological scoring systems available to measure histological activity in UC, which vary considerably in the number and range of histological features that they encompass,[122–124] and some of these systems have been validated and are reproducible. These include the Robarts histopathology index [RHI],[125] Geboes score,[126] and Nancy histology index [NI],[127] which are all widely utilized and cross-validated.[120,128–130] The NI is relatively simple, assessing only ulceration and the density of the acute and chronic inflammatory infiltrates. Due to its ease of application and rapid use, the NI is recommended for observational studies and for clinical practice.[120,131] The recent development of the PICaSSO histologic remission index [PHRI] was validated through a large multicentre study. The PHRI simplifies the evaluation of histological remission by focusing on neutrophil presence or absence in the lamina propria, surface epithelium, and crypt epithelium.[132] The PHRI also demonstrated strong correlations with endoscopic scores and clinical outcomes and has been integrated into artificial intelligence models to enhance diagnostic accuracy and standardize histological assessments in clinical practice.[133] Unfortunately, all histology scoring systems have significant limitations (Table 8). The criteria for mucosal histological remission of UC after treatment are variable and include histological normalization; absence of ulceration, erosions, and mucosal neutrophils; RHI ≤ 3; NI = 0; Geboes score ≤ 2.0; and PHRI = absence of neutrophils.

Few histological activity scores exist specifically for CD; however, none are fully validated. The most used score in clinical trials specific to CD is the Global Histological Activity Score (GHAS), developed in 1998 to assess postoperative recurrence after ileocecal resection. GHAS was later adapted for use in the terminal ileum (ileal GHAS) and the large bowel (colonic GHAS).[135] However, this score has not been validated.[123] Developing histological indices for CD is challenging. Unlike UC—which mainly affects the mucosa and submucosa in a continuous pattern—CD inflammation is often discontinuous and patchy. This complicates decisions about where to take biopsies and increases the risk of false negatives. Moreover, the predictive value of mucosal biopsy histology is lower in CD than in UC.[136] Nonetheless, many publications (including the ECCO position paper) suggest that UC histological scoring systems may be applied to CD, particularly colonic CD, despite limitations such as their unsuitability for assessing ileal mucosa.[121,137] In fact, contemporary trials of new medications do investigate histological activity in CD. For example, in a post hoc analysis of phase 2 data on mirikizumab, the investigators found that early combined histologic-endoscopic response correlated with endoscopic remission after one year of treatment.[138] Overall, a standard, straightforward, and fully validated system for assessing histological disease activity in CD is still needed.

In summary, histological remission helps predict clinical relapse and evaluate the benefit of therapy in UC, and it may serve as a therapeutic goal in clinical trials. However, additional research is needed to clarify the advantages of histological remission for patients with CD. Pathologists should use currently validated scoring systems to complement endoscopic scores in clinical practice. Of these, the NI is the most suitable for routine use.

Recommendation 42: We suggest assessing the degree of disability in patients with IBD using validated tools. [EL5]. Agreement 97%

IBD impacts a patient's physical, mental, and social health. To gain insight into the extent of disability, patient-reported outcomes (PRO) are increasingly used.[139] A PRO is any report of the status of a patient's health condition that comes directly from the patient, without interpretation of the patient's response by a clinician or by anyone else.[140] Recently, the International Organization for the Study of Inflammatory Bowel Disease (IOIBD) identified "absence of disability" as a long-term therapeutic target next to "endoscopic remission," [141] but they did not provide "remission." However, no advice was provided on which disability score is best to use. Many disability tools are too cumbersome and time consuming for meaningful consultations. Patients find them burdensome, and healthcare providers feel that they take an excessive amount of time to review. During the consultation, time must also be allocated to disease-specific history taking, physical examination, and shared decision-making regarding appropriate treatment. For a good flow in the consultation room, the patient and the doctor benefit from a disability tool with a limited number of distinctive items. Until 2010, the major focus of disease impact in IBD was on quality of life, measured by the IBD Questionnaire (IBDQ),[142] the short IBD Questionnaire (SIBDQ),[143] and the generic SF-36.[144] In recent years, more objective measures of disability have been developed.

The IBD disability index (IBD-DI) was developed in collaboration with the World Health Organization. It is designed for interviewer use and comprises 17 items assessing different aspects of disability.[145–147] IBD-DI is available in multiple languages. Currently, it is used mainly in the clinical trial setting.

The IBD disk is a shortened, patient-reported adaptation of the IBD-DI and is available in multiple languages. IBD disk is a 10-item scale with each disease impact item rated from 1 to 10. It provides an easy-to-use visual tool that allows IBD patients to communicate their disease burden to their healthcare provider effectively. It allows prompt discussion of disability in the consultation room and tracks changes over time.[148,149] In a recent publication on patients with UC, histo-endoscopic remission correlated well with a low disability score as assessed with the IBD disk.[150] A practical step-by-step plan to incorporate disability scores in daily clinical practice is[1] asking the patient to complete a validated online tool before the clinic visit[2]; visualizing the responses in a dashboard; and[3] discussing the outcomes during the consultation. This helps the healthcare professional identify problems that matter to the patient, offer appropriate interventions, and monitor functioning over time.

Recommendation 43: We recommend fecal calprotectin testing every trimester to monitor disease activity in pregnant women with IBD [EL2]. Agreement 92%

Recommendation 44: In pregnant women with features of active IBD, we suggest IUS or MRE [without use of gadolinium] to evaluate the bowel [EL3]. Endoscopy should be reserved for situations where IUS or MRE are insufficient to make a therapeutic decision [EL5]. Agreement 100%

Table 8. Histological indices and scores for IBD.

Name of the Score	Type of IBD	Items of the score	Strengths	Limitations	Validation
NI[127]	UC [and CD]	-Chronic inflammatory cell infiltration -Acute inflammatory cell infiltration -Ulceration	-Fully validated -Simple and easy to use -Strongly correlates with histological remission and treatment response	-Refers to mild, moderate, and severe, but lacks precision regarding the cutoff points for these terms -Includes eosinophils in the chronic inflammation score	Validated
RHI[125]	UC [and CD]	-Chronic inflammatory infiltration -Lamina propria neutrophils -Neutrophils in epithelium -Erosions and ulcers	-Fully validated -Initially created to detect histological changes of UC induced by treatment		Validated
GS[126]	UC [and CD]	-Architectural changes -Chronic inflammation -Eosinophils -Lamina propria neutrophils -Neutrophils in epithelium -Crypt destruction -Erosions and ulcers	-Partially validated -Good interobserver variability -Very detailed and comprehensive -Proven to correlate with disease activity and severity -In widespread use globally for research and clinical trials	-Many items that make it complicated and time consuming to use in clinical practice -Requires training for consistent application	Partially validated
PHRI[132]	UC [and CD]	-Neutrophil infiltration	-Validated -Avoids the use of arbitrary visual scale or estimated percentages -Easy to apply -Implementable in AI systems	-Recent score and recently validated -Assesses only one histological item, as with other scores such as Truelove -Relatively new and not as extensively tested as other histological indices across different clinical settings	Validated
GHAS[134]	CD	-Epithelial damage -Chronic inflammatory cell infiltration -Crypt architectural distortion -Lamina propria neutrophils -Neutrophils in epithelium -Granulomas -Erosions and ulcers	-Applicable to multiple anatomical sites -Multiple histological features and comprehensive -Good for assessing active inflammation -Good interobserver reliability[1]	-Not validated -Large number of items -Grades intraepithelial neutrophils according to morphology [e.g. crypt abscess, cryptitis] rather than according to quantities or percentages -Some experts object to the inclusion of granulomas in the score -Not ideal for monitoring histological remission	Not validated

Abbreviations: AI = Artificial intelligence, CD = Crohn's disease, GHAS = Global histological activity score, GS = Geboes score, NI = Nancy histological index, PHRI = Paddington international virtual chromoendoscopy score histological remission index, RHI = Robarts histopathology index, UC = Ulcerative colitis.

IBD may flare during pregnancy. Pregnant women with UC are more likely to flare during pregnancy than pregnant women with CD. Several risk factors are associated with a flare, including active disease at conception and previous pregnancy flares. The presence of quiescent disease at conception reduces flare rates, especially in UC, and prior IBD-related surgery and biologic therapy also reduce flare rates during pregnancy.[151,152] Interpreting symptoms during pregnancy can be difficult as common pregnancy-related discomfort (including constipation and hemorrhoids) may mask or imitate IBD flares. Hemoglobin and albumin levels usually decrease, while erythrocyte sedimentation rate and alkaline phosphatase levels increase.[153]

Endoscopy appears to be generally safe during pregnancy when there is a clear indication, with no increased risk of adverse outcomes in most studies.[153–155] However, one registry study found an association between endoscopy and increased risk of preterm birth and low birth weight, although disease activity may be a confounder. Patients should be positioned in the left lateral position during the procedure to avoid vena cava compression.[153,154] In general, the second trimester is considered the safest period for endoscopy, as organogenesis is complete and the risk of preterm labor is lower than in the third trimester. Minimal sedation should be used, with careful monitoring of both mother and fetus.[153,154] The choice and dose of sedative medications may need to be adjusted based on physiological changes in pregnancy, such as increased volume of distribution and altered drug metabolism. Close collaboration with anesthesiology is recommended, especially for procedures in the third trimester when there is a higher risk of aspiration and a potential need for emergency delivery. Overall, endoscopy appears to be low risk when necessary during pregnancy but should be performed only when the

benefits clearly outweigh the possible risks after a multidisciplinary discussion.[153,154]

Video capsule endoscopy (CE) is relatively contraindicated due to the unknown risks of the electromagnetic field of the capsule recorder. Additionally, in the second and third trimesters, gastrointestinal transit time may be prolonged, potentially jeopardizing the procedure.[156]

There are no diagnostic studies in which noninvasive tests (fecal calprotectin [FC], IUS, or MRE) are directly compared with endoscopy in the setting of pregnancy. Unlike blood markers, FC is unaffected by pregnancy and is useful for detecting an imminent flare during pregnancy.[153,157–159] IUS is useful for detecting disease location, strictures, abscesses, and fistulas. Visualization can be limited by a gravid uterus. Two studies investigated the correlation between FC and IUS in pregnant patients with IBD.[160,161] Flanagan et al. performed a segment-by-segment IUS assessment across various stages of pregnancy. They concluded that good views could be obtained throughout the colon and terminal ileum up to 20 weeks of gestation. Beyond 20 weeks, colonic views were adequate in almost all cases but the ileocaecal valve and terminal ileum became more difficult to visualize, with an adequate window in approximately 50% of cases.[161] De Voogd et al. used a similar research design and also concluded that the view of the terminal ileum and sigmoid colon decreased significantly in the third trimester of pregnancy.[160]

The risk of MRE in pregnancy is low, and MRE is free of ionizing radiation. However, the use of gadolinium during pregnancy is not recommended due to unknown effects on the child *in utero*. Based on clinical judgment, unenhanced MRE without gadolinium remains an alternative to IUS if the latter is unavailable or insufficiently informative, and when cross-sectional imaging is required to make a clinical decision.[153]

3. General principles and technical aspects of endoscopy and cross-sectional imaging

3.1. Endoscopy

3.1.1. Sedation and monitoring during endoscopy

Recommendation 45: Sedation modalities should be guided by pre-endoscopic physical assessment, local resources, patient preferences, and adherence to local guidelines. When the endoscopist administers sedation, a trained team member should be present to monitor vital signs [EL5]. Agreement 85%

The presence of an anesthesiologist or anesthesiology-trained nurse during endoscopic procedures varies with the organization and system of each country. In the absence of access to an anesthesiologist, sedation guided by the endoscopist is necessary for lower endoscopy and in the vast majority of cases is based on fentanyl and midazolam.[162] If the patient is sedated, pulse, blood pressure, oxygen saturation, capnography, and respiration rates should be monitored during endoscopy. Advanced and prolonged therapeutic procedures may achieve better success and tolerance when performed under propofol.[163] High-quality evidence on selecting patients for deep sedation or general anesthesia is currently not available. However, staff education on sedation can potentially lead to a reduction in adverse events.[164]

Guidelines for sedation in gastrointestinal endoscopy are provided by the British Society of Gastroenterology (BSG) for anesthesiology for digestive endoscopy.[163] The sedation modalities can vary, such as with or without any sedation, under full anesthesia, or using a gas such as nitrous oxide. The decision should be made in consultation with the patient and considering the pre-operative assessment, including the American Society of Anaesthesiologists (ASA) physical status classification and local availability and constraints.

3.1.2. Bowel preparation

Recommendation 46: For colonoscopy, we suggest using bowel preparation with a split-dose polyethylene glycol-based agent [EL4]. Agreement 87%

High-quality preparation is essential for optimal colonic mucosal visualization and to facilitate chromo-endoscopy. Studies on bowel cleansing effectiveness in IBD are limited. A prospective observational study in 429 IBD patients showed inferior bowel cleansing quality compared with patients undergoing investigation for abdominal pain.[165] In a study of 100 IBD patients with age- and sex-matched controls, disease activity was not associated with inferior bowel preparation quality according to the Boston preparation scale.[166] Due to the association of aphthous ulceration with sodium phosphate use, polyethylene glycol (PEG)-based bowel cleansing agents are commonly used in IBD. In a study not performed in IBD, split-dose PEG was superior to a single dose for colonoscopy preparation.[28] Two studies compared low-volume PEG (≤ 2 L) plus adjuvant versus high-volume PEG (> 3 L). No significant difference in bowel cleansing was observed (OR: 1.19; 95% CI: 0.52–2.71). However, the low-volume regimes were more acceptable to patients (OR for willingness to repeat: 5.11; 95% CI: 1.31–20.00) for willingness to repeat.[167,168]

3.1.3. Technical requirements and training

Recommendation 47: High-definition technology is preferred over standard definition [EL3]. We suggest CO_2 insufflation for ileocolonoscopy [EL4]. We suggest that endoscopy is preferably performed by an endoscopist who is experienced in both IBD endoscopy and its clinical management [EL5]. Agreement 100%

CO_2 insufflation may reduce abdominal pain following an endoscopic procedure and therefore may be preferable during endoscopy.[169–171] A high-definition (HD) system comprises an HD endoscope, processor, cable connections, and monitor. The primary difference between HD and standard-definition endoscopy is image resolution (2 million pixels vs 300 000 pixels). This higher pixel density in HD endoscopes allows for superior image quality and more detailed visualization of the gastrointestinal mucosa. Several studies have investigated the impact of HD colonoscopy on lesion detection and revealed that HD was superior to standard-definition colonoscopy in detecting dysplastic lesions.[172–174] There is no clear evidence to recommend a specific amount and type of training for dysplasia detection. However, to ensure consistency in detecting and characterizing neoplastic or inflammatory lesions (or both) in IBD, it may be appropriate to restrict IBD endoscopy

to endoscopists with demonstrated competency and expertise in IBD-related procedures and clinical management.[175] Implementing new online training tools in gastroenterologist education programmes may help improve dysplasia characterization in IBD.[176]

3.1.4. Reporting requirements

Recommendation 48: We suggest using an electronic endoscopy reporting system with incorporated key quality indicators [EL5], preferably a system that is integrated into the hospital's electronic patient record systems [EL5], including photo documentation [either film or photograph] of key lesions [EL5]. Agreement 92%

Effective monitoring of gastrointestinal endoscopy and ensuring high-quality services necessitate easy data extraction from endoscopy reports, including procedural data, patient characteristics, and key quality indicators. Implementing standardized and quality-assured endoscopy reporting systems in daily practice is feasible.[177] Moreover, standardization improves the completeness of information included in the report, particularly the description of all relevant signs in cases of inflammation[178]

Defining a core set of elements ensures optimal recording, communication, and quality assurance. This framework enables the production of clinically valuable reports in endoscopy, surgery, and histopathology. Utilizing synoptic and structured standardized reporting enhances report completeness and supports the delivery of high-quality care.[179–182]

Photo documentation with stored pictures, film, or both is important, especially in complex cases that require discussion. As withdrawal time is associated with neoplasia detection in both IBD and non-IBD contexts, we suggest reporting the time of withdrawal when the colonoscopy is performed for dysplasia surveillance.[182,183] As a quality parameter, we suggest reporting the Boston preparation scale, which is a score with good intra-observer and inter-observer reliability, to evaluate the quality of bowel cleansing.[184]

3.1.5. Capsule endoscopy

Recommendation 49: CE interpretation should be performed by a trained reader [EL2]. We suggest against routine use of purgative bowel preparation, prokinetics, or simethicone before small-bowel CE [EL2]. Agreement 83%

Recommendation 50: CE is associated with a small risk of capsule retention [EL1]. We recommend small-bowel evaluation using a patency capsule or cross-sectional imaging in patients with established CD [EL1]. Agreement 97%

Wireless video capsule endoscopy (CE) is a method to examine the endoluminal mucosa of the bowel. This form of endoscopy is based on a pill-sized camera tool that is swallowed by the patient and travels through the patient's luminal digestive tract by relying on the intrinsic motor activity of the bowel. The capsule continuously captures images that are transmitted wirelessly to a data recorder worn by the patient. Images are downloaded and processed, and a reader with demonstrated competency in CE interpretation (preferably a gastroenterologist) examines them on a workstation using dedicated software. CE is mainly used to visualize the small-bowel mucosa in CD.

All currently available small-bowel video capsules are appropriate for IBD.[185] A capsule examination is also available to evaluate the small and large bowels (panenteric capsule).[186–188] However, panenteric capsules are less commonly used, and its added clinical benefit over small-bowel CE is unclear.

Patients should adhere to a clear liquid diet starting 24 hours before the procedure and fast for 12 hours before the procedure. Avoidance of non-steroidal anti-inflammatory drugs (NSAIDs) for at least 4 weeks is necessary.[189] There is no consensus on the benefit of purgative preparation for CE. Although some societies have previously recommended such preparation[189] and it does improve visibility,[189] its benefit to diagnostic yield could not be established.[190,191] Moreover, purgative preparation is a significant burden for the patient. Similarly, no benefit in the diagnostic yield could be established for using simethicone as an adjunct to purgative bowel preparation[192] or for using prokinetics.[193] If a purgative bowel preparation is used, there is no clear recommendation on the dosage and timing of administration.[194] Although an extensive purgative preparation with additional boosters after capsule ingestion is needed if colonic evaluation is required,[186] the optimal preparation mode is not established. Documentation of the procedure and its findings in IBD patients undergoing CE should be standardized. IBD-specific scales, such as the Lewis score and the CE CDAI are encouraged.[186,195,196] The Lewis score is embedded in the reading software of some capsule models. For panenteric capsule procedures, a recently published score derived from parameters incorporated in the reading software (Eliakim score) can be used.[186] The European Society of Gastrointestinal Endoscopy (ESGE) suggests that CE recordings should be read at a maximum speed of 10 frames per second in a single-view mode. Double- and multiple-view modes, if available, at a maximum speed of 20 frames per second are also acceptable.[189]

The main complication of CE is capsule retention in the small bowel, defined as non-passing of the capsule in the stool within 14 days.[197] Capsule retention is usually a minor complication; in most patients, it is asymptomatic[198] and will spontaneously resolve. Nonetheless, small-bowel obstruction or perforation can occur.[199] In some patients, a short course of corticosteroids may result in capsule excretion. In others, endoscopic or surgical retrieval of the retained capsule will be required.[200] There is no consensus regarding the optimal timing of such intervention in asymptomatic retention cases. MRI is contraindicated in patients with a retained capsule.[200] Risk factors for capsule retention are small-bowel CD, prior abdominal surgery or radiation, presence of obstructive symptoms, or history of chronic NSAID use.

The retention risk in suspected and established CD is 2.4% and 4.6%, respectively.[197] Rates of capsule retention are potentially 50% lower in studies that use either a patency capsule or a cross-sectional imaging technique (such as MRE or computed tomography enterography [CTE]) to assess patency before performing CE.[201] Small-bowel patency assessment is not routinely required in patients with suspected CD without other risk factors for retention.[202]

A patency capsule is a dummy capsule identical in size to the video capsule. It is filled with lactose admixed with barium, which can be radiographically detected and is self-dissolvable. A negative patency capsule test is defined as the excretion of an intact patency capsule in the stool or the absence of the capsule on an abdominal X-ray or CT scout image performed within 30 hours of ingestion. A positive patency capsule test means that the patency capsule failed to pass through the gastrointestinal tract within the specified timeframe (typically 24–33 hours after ingestion). Specifically, this can be characterized by the following: non-passage of the capsule, the intact patency capsule is not observed in the patient's stool within the designated timeframe conjoined with a radiological confirmation, or symptomatic retention when patients experience abdominal pain or other symptoms related to capsule retention. In patients with a positive patency capsule test, CE is contraindicated as it may result in retention in at least 20% of the cases.[203] Moreover, localization of a retained patency capsule to the small bowel or colon by plain abdominal X-ray is not recommended. Such localization is highly inaccurate[204] and may lead to false negatives of a retained patency capsule. If the patency capsule is visible on an abdominal X-ray, this should be considered as positive unless localization by low-radiation abdominal CT (in a very select subgroup of patients where such an approach could be clinically justified) is performed.[204] As mentioned, cross-sectional imaging can also assess small-bowel patency,[205] although the agreement with patency capsule results is variable.[200]

3.1.6. Device-assisted enteroscopy

Recommendation 51: We suggest using device-assisted enteroscopy diagnostically to enable assessment and biopsy sampling of small-bowel mucosa [EL2] and for therapeutic procedures [EL3]. Agreement 87%

In contrast to conventional push enteroscopy, which can access only the proximal small bowel, device-assisted enteroscopy (DAE) enables direct visualization of the entire small bowel, along with biopsy sampling and therapeutic interventions. A complete examination of the small bowel is achievable in 44–80% of patients in experienced centers.[206] DAE assists in diagnosing CD, excluding CD, and diagnosing alternative conditions, such as NSAID enteropathy.[207,208] However, it is rarely used to diagnose and grade disease extent and severity in the small bowel, as it is invasive. Complete enteroscopy is required for this purpose.[209]

Disease activity noted at enteroscopy is graded according to the simplified endoscopic activity score for CD.[209–211] In a study on 123 patients with CD, the simple endoscopic index for CD score correlated well with FC levels, even in patients with active disease of the small bowel only as evaluated by balloon-assisted enteroscopy (a type of DAE) in combination with CTE.[212] Similarly, FC correlated well with endoscopic remission, as demonstrated by DAE.[213]

DAE is mostly used for therapeutic procedures, such as capsule retrieval, dilatation of short fibrotic strictures, and bleeding intervention.[214,215] Endoscopic balloon dilatation of strictures in CD is effective and relatively safe.[216,217] In a multi-center study, DAE of small-bowel strictures was technically successful in 89/95 patients (93.7%), a rate equivalent to the outcomes of conventional endoscopic balloon dilation for strictures of the large bowel and ileo-colonic anastomoses.[216] Furthermore, the use of DAE reduces the need for surgery.[216,218,219] Approximately 80% of CD patients who had small-bowel balloon dilation remain symptom-free after 3 years, although nearly half will require at least one re-dilation procedure. The mean diameter of dilation reported is 12–15 mm, with an overall complication rate of 4.8% per patient and 2.6% per dilation.[218]

DAE comprises balloon enteroscopy and spiral enteroscopy; balloon enteroscopy can be further subdivided into balloon-guided enteroscopy and balloon-assisted enteroscopy, which can be performed with either a single-balloon enteroscope or a double-balloon enteroscope.[215,220–225] There are insufficient data to recommend any specific approach to DAE.[202] Comparison of single- and double-balloon enteroscopy, for example, showed a similar diagnostic yield and safety profile in both techniques.[226] Given the similarities between techniques, the choice of enteroscopy depends mainly on local expertise and availability.[221,227–230]

For antegrade DAE, 8–12 hours of fasting from solid food and 4–6 hours of liquid avoidance before the procedure are advised. For retrograde DAE, a standard colonoscopy preparation regimen is required.[189,227,230] DAE is clinically challenging and requires conscious sedation, deep sedation, or general anesthesia with endotracheal intubation.[231] CO_2 insufflation instead of room air is highly recommended in DAE, as this may increase the insertion depth, shorten procedure time, and reduce the likelihood of post-procedural symptoms.[228,229] Recent studies suggest that water instead of CO_2 for luminal distension, as for colonoscopy, can be applied successfully in DAE. However, these results are preliminary.[202,229]

DAE is relatively safe. According to meta-analyses, pooled minor and major complication rates were 9.1% and 0.72%, respectively. The most common minor complications are abdominal pain and vomiting, while major complications include perforation, pancreatitis, bleeding, and aspiration pneumonia.[215,232]

3.2 Cross-sectional imaging

3.2.1. Magnetic resonance enterography

Recommendation 52: MRE should be performed with a suitable oral contrast agent such as mannitol or PEG [EL3]. Contrast-enhanced images using intravenous gadolinium are suggested for assessment of perianal fistulizing disease [EL3]. Routine use of contrast-enhanced images using intravenous gadolinium may not be necessary in MRE studies [EL2]. Agreement 89%

Magnetic resonance enterography (MRE) typically does not require the extensive bowel preparation associated with colonoscopy. Most centers recommend fasting for about 4–6 hours before the exam to reduce bowel contents and motion, which helps improve image quality. Patients are often asked to drink a specified volume of oral contrast solution (sometimes water, or a specially formulated solution) about 45–60 minutes prior to scanning to distend the small bowel for better visualization. A full bowel prep (like that used for colonoscopy) is usually not required; however, some facilities may give mild laxatives or suggest a low-residue diet the day before, but this varies by institution. Shortly before or during the scan, patients may receive an IV injection of an anti-spasmodic (eg, glucagon) to reduce bowel motion and improve image clarity. Additionally,

sometimes IV gadolinium-based contrast material is used to help visualize inflammation, fistulas, and other abnormalities.

A prospective multicentre study demonstrated that mannitol-based solutions and PEG generally achieve comparable distension quality and have similar side effect profiles. Mannitol may achieve better distension for the jejunum. Increasing the ingested volume > 1000 mL does not alter distension quality or the side-effect profile.[233–235] Additionally, gastric and small-bowel distension are better with a 45-minute drinking time than 60 minutes.[236] Patients should be informed about possible side effects of oral contrast agents, particularly cramping and diarrhea. According to one report, antispasmodics do not improve the quality of images acquired with single-shot fast spin-echo sequences.[236] However, antispasmodics improve the accuracy of diffusion-weighted imaging (DWI). The use of such agents is recommended but not obligatory.[237,238]

Several studies attempted to review the diagnostic accuracy of different MRE sequences. Some studies concluded that adding other sequences does not improve the accuracy provided by T2 sequencing alone,[100,233,239,240] whilst others concluded that the accuracy provided by T2 and DWI does not increase due to the addition of post-contrast T1 sequences.[241–244] Omitting post-contrast sequences from routine MRE protocols provides a better patient experience and healthcare efficiency. However, a meta-analysis and other studies report that patterns of enhancement on post-contrast sequences (in particular layered enhancement) help diagnose active inflammation and fibrosis.[245,246] Dynamic contrast-enhanced MRI parameters continue to show association with active inflammation but are cumbersome to acquire in routine clinical practice.[247–250] Contrast-enhanced sequences are helpful in the assessment of perianal CD, allowing differentiation between abscesses, fluid, and granulation tissue, which may affect immediate management and facilitate disease activity response assessment.[248,251–254] DWI may have utility in assessing inflammatory activity, but its role remains undefined. The literature around the accuracy of DWI-MRE is heterogeneous. Recent single-center studies support the utility of qualitative DWI assessment in disease identification[255] and DWI or ADC measurements in quantifying active inflammation and fibrosis.[256–260] However, there is an overlap between the appearance of both with histological processes.[114,261]

Some new magnetic resonance techniques have been described. Quantified motility imaging was recommended as an optional sequence previously[234] and has since been investigated in several multicentre prospective studies for its role in treatment response assessment[262–266]; these studies have further promoted its use as a meaningful additional sequence. Early but promising data are also available on the utility of mural and mesenteric assessment with MRI elastography,[267,268] T2 and post-contrast texture analysis,[253,269] T1 mapping,[270] and magnetization transfer ratio in fibrosis.[271] However, such techniques require prospective multisite validation. MRE examinations may be used for sarcopenia assessment and, in this setting, are related to disease activity and prognosis and may be of significant utility.[272,273]

3.2.2. Computed tomography

Recommendation 53: Radiation exposure is a considerable limitation of CT and therefore CT should mainly be used outside the acute setting when MRI or ultrasound are not available [EL2]. Agreement 97%

CT allows rapid acquisition of high-resolution images. CTE and CT enteroclysis require a scanner with at least 16 slices but ideally with 64 slices or greater. However, comparative studies are not available.

Good patient preparation is essential for acquiring diagnostic images. Oral contrast preparation should be used to achieve sufficient bowel distension, improving diagnostic accuracy.[274] Oral preparations are essentially those used for MRE, such as mannitol, PEG, sorbitol, or combinations thereof.[275] As for MRE, it is recommended to ingest oral contrast agents 45–60 minutes before the examination with an ingested volume of around 1000 mL. Patients should also be informed about possible side effects of oral contrast agents, particularly cramping and diarrhea.

Images should be acquired following intravenous contrast agent administration in the enteric or portal venous phase only.[276] Iodinated contrast administration facilitates assessment of the bowel-wall enhancement pattern and mesenteric vascularity. The use of multiplanar reformats is mandatory during CT evaluation, and these should be reconstructed at ≤ 3 mm.[274]

Radiation exposure must be considered when using CT in IBD patients. Imaging patients with IBD often starts when they are young, which can result in excessive cumulative dose exposure over the whole disease course with repeated use of techniques that involve ionizing radiation.[277] Depending on the protocol and CT technology, CT enteroclysis and CTE can impart large radiation doses of up to 10–15 mSv.[278] Estimates of the adult patient's lifetime risk of acquiring a fatal cancer from radiation are 1 in 20 000 per mSv.[279] One study even showed that in 15% of patients, the cumulative effective radiation dose was more than 75 mSv, which increases cancer mortality by an estimated 7%.[280] In particular, IBD patients with complicated diseases are more prone to repeated CT scans with a high cumulative radiation dose.[281]

However, advances in CT technology and image reconstruction techniques mean doses can be considerably reduced. If CT is used, low-radiation, high-contrast CTE protocols should be standard. For example, dual-source or ultra-high-pitch CT scanners can reduce dose[282–289] and use iterative reconstruction systems, allowing simultaneous reduction of image noise and generation of quality CT images.[284,290,291] Optimizing tube voltage and current[292,293] and using a low-radiation high-contrast protocol[293,294] can also reduce the dose. Furthermore, good data demonstrate that iterative reconstruction techniques (such as ASIR, IRIS, SAFIRE, and MBIR) significantly reduce dose while producing diagnostically acceptable images[290,291,295–298]; these techniques should be applied routinely when available. The first European Society of Gastrointestinal and Abdominal Radiology (ESGAR)/European Society of Paediatric Radiology (ESPR) consensus statement recommends maintaining a log of radiation exposure for patients with IBD undergoing repeat medical imaging.

Due to the risks from repeated radiation exposure, given the chronic nature of the disease, and the need for repeated imaging outside the acute setting, MRE and IUS are preferred.[234]

Several studies have used a radiomics approach, a rapidly evolving field of radiological research, to study IBD patients and to develop decision support tools. Radiomics extracts quantitative metrics, or so-called radiomic features, within medical images. Radiomic features capture tissue and lesion characteristics, such as heterogeneity and shape, and may, alone or in combination with demographic, histological, genomic, or proteomic data, be used for clinical problem-solving.

Radiomics have been used to study intestinal fibrosis,[299] assess mucosal healing,[300] investigate mucosal activity[301] and postoperative recurrence,[302] and even predict disease progression in CD patients.[303] However, research is currently at an early stage.

3.2.3. Intestinal ultrasound

Recommendation 54: IUS should be performed with an IUS-dedicated multifrequency probe [EL3]. Fasting is usually not required when performing IUS [EL3]. Routine use of oral contrast is not recommended but may be used in specific scenarios to increase visualization of the small bowel [EL3]. Agreement 94%

IUS is a well-tolerated, noninvasive, and cost-effective cross-sectional imaging modality that is free of ionizing radiation and can be performed in the radiology department or the clinic at point-of-care or bedside.[304–306] There is increasing use of IUS globally, a growing body of evidence for its value, and increasing standardization for clinical use and research practice.[307,308] Although proximal small-bowel assessment can be challenging, IUS performs well in colonic and terminal ileal diseases.[309] IUS can be performed post-prandial, although many trials have chosen to standardize the procedure by adding a 4–8-hour fasting period as this may influence blood flow and peristalsis.[306,307,310,311] Oral contrast is rarely routinely applied, as this adds time and complexity in the point-of-care setting, which is one of the key specific advantages of IUS. However, if oral contrast is used, the technique is referred to as Small Intestinal Contrast Ultrasound (SICUS). In this method, PEG is used as the contrast agent. Typically, patients ingest 250–500 mL (range 125–800 mL) of PEG solution 30-40 minutes before the examination to enhance small-bowel visualization and enable more accurate classification of strictures.[312–315]

IUS should be performed with a mid- or high-range ultrasound machine with a mid- or high-range multifrequency probe covering at least 5–8 MHz for B-mode and color Doppler imaging. An abdominal curved array probe with lower frequencies down to 1–5 MHz may be helpful to increase visualization of the bowel and pathology beyond the reach of the mid- or high-range probe. A systematic approach should be used for scanning all colonic bowel segments and the small bowel, and we suggest scanning the bowel both longitudinally and cross-sectionally.[260,304–306,308,313,314,316–318]

Assessing BWT (measured in mm) and color Doppler signal (using low-flow settings between 5–7 cm/s) is recommended for all examinations. The same probe type and constant machine settings should be used for follow-up examinations. The rectum is usually not routinely assessed using a high-frequency probe. However, it may be adequately visualized using abdominal or low-frequency probes.[309,316,318,319] There is emerging evidence on assessing the rectum using the perianal approach.[320–323]

Recommendation 55: We recommend against the routine use of contrast-enhanced ultrasound to quantify bowel-wall perfusion [EL2]. We recommend against the routine use of real-time tissue elastography and shear wave elastography [EL2]. Agreement 97%

Several studies examined mural perfusion with contrast-enhanced ultrasound (CEUS). Sulfur hexafluoride microbubbles have been used at 1.2–4.8 mL,[310,324] whereas other studies have used Perflutren microspheres as 0.4-mL bolus injections flushed by 5–10 mL saline.[305,311] For quantification purposes, various types of software can analyze bubble signal intensity within a region of interest (ROI) and generate a time-intensity curve from which multiple time, intensity, or combined parameters can be evaluated.[311,317,325,326] Significant heterogeneity exists between studies, including ultrasound machine types and settings, contrast doses, analysis software, and time-intensity curve parameters of importance. Most studies are single-center studies, and there are few comparisons between centers, machines, and software. Cross-machine validation, repeatability, reliability, and validation studies are needed before routine clinical use is recommended.[305,306,310,317,327,328]

Ultrasound elastography is useful as a noninvasive liver assessment, and interest in applying this modality to IUS has grown in recent years. Elastography assesses tissue deformation by an external force. Two types of elastography exist, namely real-time tissue (RTE) or strain elastography using a manually applied pressure (eg, with the probe) or shear wave elastography using the probe to generate a repeatable amount of acoustic force for tissue propagation. Readouts can appear as elastograms or mean within a prespecified ROI as a point shear wave or as a post-force applied ROI (named two-dimensional [2D]), which is typically guided by a color or heat map overlay of the b-mode picture. A median or mean of several measures and ROIs are applied to minimize variability. Although objective numbers are provided, all subtypes are prone to significant uncertainties and operator dependence from ROI size and placement. Often, the ROI size is greater than the bowel wall, and there needs to be a consensus on placement. Bowel peristalsis and surrounding tissue stiffness may also change between patient measures, and this seems to be an additional challenge in RTE or strain elastography, which needs strain ratio measures. Cross-machine validation, repeatability, reliability, and validation studies are needed before routine clinical use is recommended.[315,324,325,329–339]

3.2.4. Reporting cross-sectional imaging

Recommendation 56: All cross-sectional imaging [IUS, MRE, and CT] reporting should include an indication, scan quality, and any uncertainties in interpretation. The description of all segments examined should be reported in detail and images stored and available in an electronic patient file. We recommend using a picture archiving and communication system for digital storage [EL3]. Agreement 94%

All imaging procedures are prone to subjectivity and inter- and intra-operation variability. For example, the image interpreter usually generates the images for analysis in endoscopy and ultrasound.[304,340] Newly developed consensus standards for reporting based on systematic reviews have been published.[248] Here, clear statements on structured reporting, including indication, technical aspects, examination extent, quality, and any impact on diagnostic confidence, should be reported along with a detailed description of disease features and complications. Further, reporting BWT and color Doppler signals is recommended in all IUS examinations, and adjunctive acquisition techniques should be reported.

In follow-up examinations, a clear opinion should be noted regarding potential changes in disease activity compared with prior imaging. Images and cine-loops (for IUS) must be saved digitally, ideally in a picture archiving and communication system (PACS), which provides access to all healthcare professionals. In certain situations (eg, purely for training purposes, some bedside scans, or scans with very poor visualization), reporting may be less detailed or unreported.[248,341] The ECCO topical review on cross-sectional imaging provides specific information on standard terminology and minimum reporting requirements and includes a list of essential reporting items.[248]

3.2.5. Small-bowel follow-through and enteroclysis

Recommendation 57: We suggest against routine use of small-bowel follow-through and small-bowel enteroclysis for evaluation of IBD [EL5]. Agreement 100 %

Small-bowel follow-through (SBFT) and small-bowel enteroclysis (SBE) have long been used to assess the small bowel in IBD. Digital fluoroscopy technology is now routinely accessible, allowing for reduced radiation exposure and enabling real-time image projection and image storage. Radiation doses are often lower than CT, depending on the time of the procedure.[278,342]

SBFT and SBE typically require fasting overnight; a fast of at least 6 hours before the procedure is recommended. SBFT is usually well tolerated and requires intake of an oral contrast agent, often barium sulfate, with an individualized volume typically between 400 and 600 mL. Fluoroscopic images with and without external compression are acquired as the contrast passes through the small bowel. SBE may improve bowel visualization (eg, skip lesions and strictures) via better distension.[343] However, SBE requires nasoenteric tube insertion, which adds to the complexity of the examination, increases the radiation dose, and is more invasive. Despite compression, there may be inadequate visualization of overlapping small-bowel loops, particularly in those with abdominal pain limiting compression.[344]

SBFT and SBE have largely been replaced by cross-imaging modalities [MRE, IUS, and CTE].[344] Such techniques allow assessment of the bowel wall and extraenteric complications beyond the mucosa and facilitate evaluation of activity and treatment response. In a study on 40 consecutive CD patients, there was no difference between MRE and MR enteroclysis for detecting stenosis and fistulae and both were better than SBE. Furthermore, CE and double-balloon enteroscopy are superior to SBE for assessing mucosal disease in CD.[345]

Fewer radiologists are performing small-bowel fluoroscopy, and thus fewer are available to provide training on performing and interpreting SBFT and SBE.[346] Nevertheless, fluoroscopic techniques still have a role, particularly in addressing any uncertainties that remain after cross-sectional imaging, endoscopy, or both. For example, strictures and fistulae are still reasonably well visualized on SBFT and SBE, with reported accuracies of approximately 80%.[347,348] Fluoroscopic techniques may visualize superficial abnormalities more effectively than cross-sectional imaging (particularly ulcers) via detailed surface pattern depiction.[349,350] Another example is a visualization of the prestomal loop, which is often suboptimal on cross-sectional imaging due to under distention, or in the case of IUS, poor accessibility. The pre-stomal bowel may be better evaluated using luminal contrast and fluoroscopy in either an anterograde or retrograde manner.

3.3. Training

Recommendation 58: We suggest specific training for performing and interpreting all procedures undertaken for the diagnosis and monitoring of IBD [EL5]. Agreement 95%

The ESGE provides structured and evidence-based guidance on the requirements and processes involved in basic gastrointestinal endoscopic procedures. This involves a multimodal approach that includes procedural thresholds and measuring and documenting key performance indicators.[227] However, given the complexity of IBD, it may be more appropriate for endoscopy to be performed by experienced endoscopists regularly involved in clinical management of IBD and in performing such procedures. Online tools are also available for this training.[175,176] Table 9 summarizes the training requirements and preparation required for the tests. Further in-depth information can be found in the relevant section.

CE should be performed by a healthcare professional with demonstrated experience in conducting, interpreting, and reporting CE procedures[194–196,351] The ESGE suggests a minimum of 30 supervised CE readings for a physician to review CE independently; a dedicated CE course is considered beneficial.[352] In general, gastroenterologists with experience in conventional endoscopy should evaluate CE in IBD patients.

While some guidelines suggest volume thresholds for institutional training, such as centers offering DAE performing at least 75 procedures per year with structured exposure to retrograde and therapeutic procedures,[352,353] these numbers should be interpreted with caution, as center-based volumes may not directly reflect individual operator expertise.

A study evaluating MRE suggested that feedback on approximately 100 cases may be required to achieve diagnostic accuracy equivalent to experienced radiologists.[353] Importantly, no consistent difference in accuracy of interpretation was observed between readers with more or less than five years of experience.[235,247,354]

There is evidence of a learning curve in the interpretation of CTE. Moderate-to-good interobserver agreement has been reported for CTE,[355] and some studies suggest higher reader agreement for CTE over MRE.[356] IUS is one of the more technically challenging ultrasound procedures, and significant supervised training (ranging between 80 and 200 supervised cases) is needed to gain sufficient knowledge and interpretational and technical skills.[319] ECCO, ESGAR, and IBUS provide specific educational programmes for IUS training, in close collaboration. Guidelines for standardized reporting and documentation of cross-sectional imaging in IBD have recently been developed[248] and are part of the curriculum.

Ultimately, individual competency-based evaluation may be the best approach for all endoscopic and imaging interpretations.[357]

All pathologists reporting IBD biopsies and resections must have full training in histopathology reporting and recognition of training completion by a national organization or equivalent body. Pathologists reporting IBD should

Table 9. Preparation required for auxiliary tests and training requirements.

	Preparation	Suggested Training
Colonoscopy*	Fasting and split-dose PEG-based agents	ESGE guidance on endoscopy training and further training in IBD
CE*	Clear liquid diet starting 24 hours, fast for 12 hours pre-procedure. NSAID avoidance for at least 4 weeks	Minimum of 30 supervised CE Dedicated CE course Experience in IBD
Antegrade DAE*	8–12 hours fasting from solid food and 4–6 hours from liquids	75 procedures, 35 of which retrograde DAEs, with 50% of the DAEs being therapeutic
Retrograde DAE*	A standard colonoscopy preparation regimen is required	
CTE*	Ingestion of 1 L oral contrast agents 45–60 minutes pre- examination	Minimum of 100 IBD cases
MRE*	Ingestion of 1 L of mannitol-based or PEG solutions 45 minutes pre-examination	Minimum of 100 IBD cases
IUS*	Fasting not usually required Oral contrast agents are not routinely used	IBUS curriculum and certificate 80–200 supervised cases

Abbreviations: CE = Capsule endoscopy, DAE = Device-assisted enteroscopy, CTE = Computed tomography enterography, ESGE = European Society of Gastrointestinal Endoscopy, IBD = Inflammatory bowel disease, IBUS = International Bowel Ultrasonography Group, MRE = Magnetic resonance enterography; NSAID = Non-steroidal anti-inflammatory drugs, IUS = Intestinal ultrasound, PEG = Polyethylene glycol.
*Competency-based evaluation to achieve independence.

ideally have a formal special interest in GI pathology. In the specific setting of dysplasia complicating IBD, most societies and organizations recommend the input of an expert GI pathologist, a pathologist with a special interest in GI pathology, or both. However, definitions of an "expert" or of "special interest" are often vague or non-existent.[358] Regarding statements on the necessary level of experience, there are no formal guidelines indicating or suggesting the number of IBD biopsy or resection assessments a histopathologist must undertake before reaching a level of expertise necessary for independent assessment and interpretation of IBD cases. Indeed, training in IBD pathology assessment is in practice always part of an overall pathology training and experience programme. Some countries have specific training in GI pathology, but few, if any, have specific training in IBD pathology. However, many publications and reviews address the topic of IBD pathology reporting and the application of histology scoring systems,[120,121,137,359,360] and there are some self-standing formal guidelines from societies on the fundamental aspects of IBD pathology reporting.[361] Furthermore, there is increasing guidance on the approach to reporting IBD pathology and on standards of practice in IBD pathology as a component of more extensive guidelines on IBD or guidelines on pathology from various organizations and societies, including ECCO, the Royal College of Pathologists, and the BSG.[121,179,361–363]

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Conflict of Interest

ECCO has diligently maintained a disclosure policy of potential conflicts of interests (CoI). The conflict-of-interest declaration is based on a form used by the International Committee of Medical Journal Editors (ICMJE). The COI statement is not only stored at the ECCO Office and the editorial office of JCC but also open to public scrutiny on the ECCO website [https://www.ecco-ibd.eu/about-ecco/ecco-disclosures.html], providing a comprehensive overview of potential conflicts of interest of authors.

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Supplementary Data

Supplementary data are available online at *ECCO-JCC* online.

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