Validation of a new optical diagnosis training module to improve dysplasia characterization in inflammatory bowel disease

Iacucci, Marietta; Bonovas, Stefanos; Bazarova, Alina; Cannatelli, Rosanna; Ingram, Richard J.M.; Labarile, Nunzia; Nardone, Olga Maria; Parigi, Tommaso Lorenzo; Piovani, Daniele; Siau, Keith; Smith, Samuel C.L.; Zammarchi, Irene; Ferraz, Jose G.P.; Fiorino, Gionata; Kiesslich, Ralph; Panaccione, Remo; Parra-Blanco, Adolfo; Principi, Mariabeatrice; Tontini, Gian Eugenio; Uraoka, Toshio

DOI:
10.1016/j.gie.2023.11.018

Document Version
Publisher's PDF, also known as Version of record

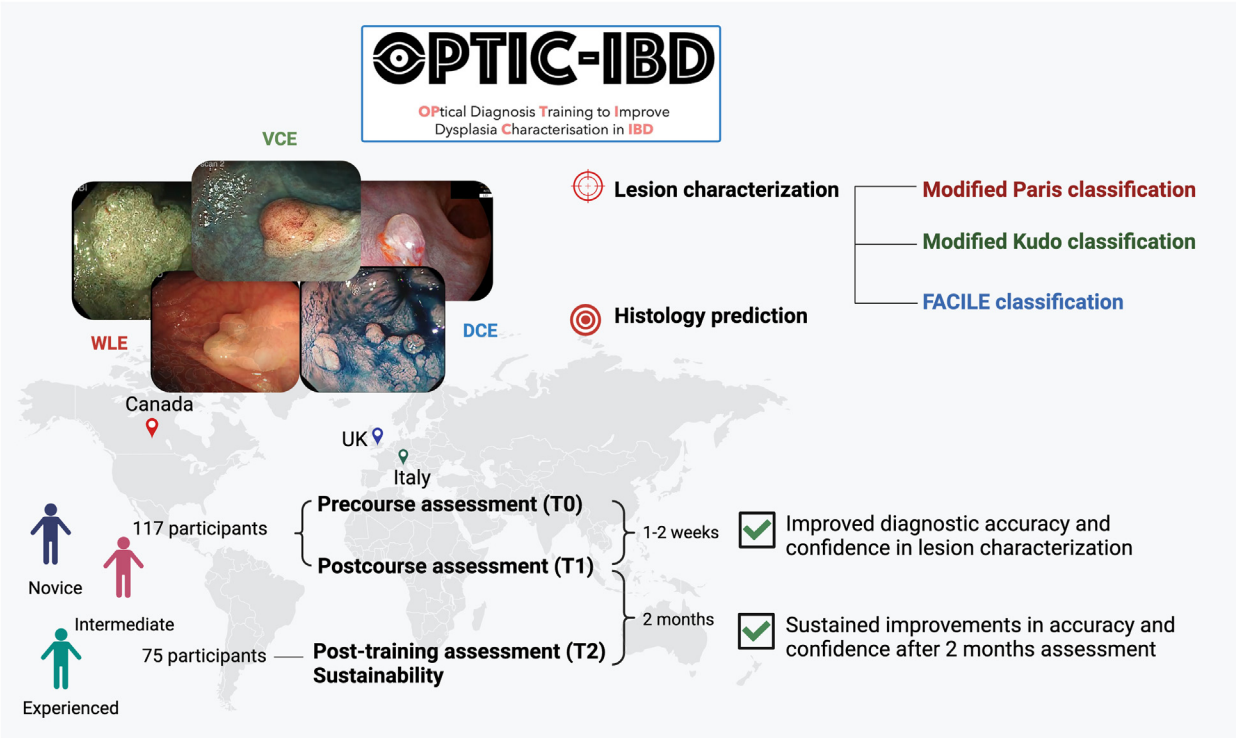
Citation for published version (Harvard):
Iacucci, M, Bonovas, S, Bazarova, A, Cannatelli, R, Ingram, RJM, Labarile, N, Nardone, OM, Parigi, TL, Piovani, D, Siau, K, Smith, SCL, Zammarchi, I, Ferraz, JGP, Fiorino, G, Kiesslich, R, Panaccione, R, Parra-Blanco, A, Principi, M, Tontini, GE, Uraoka, T & Ghosh, S 2024, 'Validation of a new optical diagnosis training module to improve dysplasia characterization in inflammatory bowel disease: a multicenter international study', *Gastrointestinal Endoscopy*, vol. 99, no. 5, pp. 756-766.e4. https://doi.org/10.1016/j.gie.2023.11.018

Validation of a new optical diagnosis training module to improve dysplasia characterization in inflammatory bowel disease: a multicenter international study

Marietta Iacucci, MD, PhD,[1,2,3,4] Stefanos Bonovas, MD, PhD,[5,6] Alina Bazarova, PhD,[7,8] Rosanna Cannatelli, MD,[1,9] Richard J. M. Ingram, MD, PhD,[1,4] Nunzia Labarile, MD,[10] Olga Maria Nardone, MD, PhD,[1,11] Tommaso Lorenzo Parigi, MD,[1,12] Daniele Piovani, PhD,[5,6] Keith Siau, MBChB, MRCP,[13] Samuel C. L. Smith, MD,[1] Irene Zammarchi, MD,[2,3] Jose G. P. Ferraz, MD, PhD,[4] Gionata Fiorino, MD, PhD,[14,15] Ralph Kiesslich, MD,[16] Remo Panaccione, MD,[4] Adolfo Parra-Blanco, MD, PhD,[17] Mariabeatrice Principi, MD, PhD,[18] Gian Eugenio Tontini, MD, PhD,[19,20] Toshio Uraoka, MD, PhD,[21] Subrata Ghosh, PhD, FMedSci,[2,3] OPTIC-IBD Study Group

Birmingham, Truro, Nottingham, United Kingdom; Cork, Ireland; Calgary, Canada; Milan, Castellana Grotte, Naples, Bari, Italy; Jülich, Wiesbaden, Germany; Maebashi, Japan

GRAPHICAL ABSTRACT



Background and Aims: Inflammatory bowel disease (IBD) increases risk of dysplasia and colorectal cancer. Advanced endoscopic techniques allow for the detection and characterization of IBD dysplastic lesions, but specialized training is not widely available. We aimed to develop and validate an online training platform to improve the detection and characterization of colonic lesions in IBD: OPtical diagnosis Training to Improve dysplasia Characterization in Inflammatory Bowel Disease (OPTIC-IBD).

Methods: We designed a web-based learning module that includes surveillance principles, optical diagnostic methods, approach to characterization, and classifications of colonic lesions using still images and videos. We invited gastroenterologists from Canada, Italy, and the United Kingdom with a wide range of experience. Partic-

ipants reviewed 24 educational videos of IBD colonic lesions, predicted histology, and rated their confidence. The primary endpoint was to improve accuracy in detecting dysplastic lesions after training on the platform. Furthermore, participants were randomized 1:1 to get additional training or not, with a final assessment occurring after 60 days. Diagnostic performance for dysplasia and rater confidence were measured.

Results: A total of 117 participants completed the study and were assessed for the primary endpoint. Diagnostic accuracy improved from 70.8% to 75.0% ($P = .002$) after training, with the greatest improvements seen in less experienced endoscopists. Improvements in both accuracy and confidence were sustained after 2 months of assessment, although the group randomized to receive additional training did not improve further. Similarly, participants' confidence in characterizing lesions significantly improved between before and after the course ($P < .001$), and it was sustained after 2 months of assessment.

Conclusions: The OPTIC-IBD training module demonstrated that an online platform could improve participants' accuracy and confidence in the optical diagnosis of dysplasia in patients with IBD. The training platform can be widely available and improve endoscopic care for people with IBD. (Clinical trial registration number: NCT04924543.) (Gastrointest Endosc 2024;99:756-66.)

(footnotes appear on last page of article)

Patients with inflammatory bowel disease (IBD) have an increased lifetime risk of colorectal cancer compared to the general population.[1] This risk is mainly determined by disease extent, disease duration, severity of inflammation, and the presence of primary sclerosing cholangitis. Consensus guidelines recommend that patients with colitis should undergo regular surveillance colonoscopy at intervals determined by underlying risk factors.[2,3]

International consensus and major guidelines[2,4,5] recommend performing surveillance colonoscopy with dye chromoendoscopy (DCE) or virtual chromoendoscopy (VCE). VCE technologies, such as Olympus Narrow-Band Imaging (Olympus, Tokyo, Japan), Fujifilm Blue Light Imaging and Linked Colour Imaging (Fujifilm, Tokyo, Japan), Fujinon Intelligent Colour Enhancement (FICE, Fujinon, Tokyo, Japan), and Pentax i-SCAN (Pentax, Tokyo, Japan), with or without optical magnification, are now widely available and in expert hands improve lesion detection, characterization, and histology prediction.[6-8]

The European Society of Gastrointestinal Endoscopy (ESGE) and the American Society for Gastrointestinal Endoscopy (ASGE)[4] highlight the importance of dedicated IBD endoscopy training to assess lesions and effectively target biopsies. Indeed, previous studies have shown that even among experts using advanced endoscopy, distinction between non-neoplastic and neoplastic lesions and characterization remain challenging.[9,10]

Optical diagnosis training should include lesion classifications and self-learning with a minimum colonoscopy detection rate. Because a validated training module is not yet available for optical diagnosis of colonic lesions in IBD, the ESGE curriculum[11] suggests attending an onsite training course with an expert to acquire lesion detection and characterization skills. They recommend performing at least 20 DCEs with at least 20 targeted biopsies and histologic feedback, with 4-quadrant biopsies as backup during the learning process. The transition from DCE to VCE should be gradual after endoscopists achieve the learning goals and demonstrate competence. The ESGE recommends IBD optical diagnosis competence as a dysplasia detection rate of $\geq$10% in 20 panchromoendoscopy colonoscopies with targeted biopsies. Moreover, competence should be maintained by auditing $\geq$10 IBD endoscopic lesions within 1 year.

As technology provides ever greater image resolution, adequate training is crucial. Mucosal distortion caused by chronic inflammation and regenerative changes can conceal dysplasia and lead to misdiagnosis.[12] Hence, training is needed to improve detection, recognize subtle changes, standardize reporting, and guide clinical management. Because IBD-associated lesions differ from those found in the general population, so do their respective classifications. The classifications used for IBD lesions are outlined in the Surveillance for Colorectal Endoscopic Neoplasia Detection and Management in IBD Patients (SCENIC) classification[5] that uses modified Paris descriptors; the Kudo pit pattern,[13] including the II-O adaptation[14]; Hazewinkel criteria for sessile serrated adenoma/polyp[15]; the Frankfurt Advanced Chromoendoscopic IBD Lesions (FACILE),[16] and the Five S.[17] Despite the abundance of systems, their adoption in clinical practice remains modest, partially because of a lack of training.[5] The study's overall objective was to assess the feasibility of introducing the OPTIC-IBD training module as a standard validated tool to improve the diagnostic accuracy of IBD-associated dysplastic lesions. The primary aim was to design the OPTIC-IBD training module and measure its impact on the diagnostic accuracy of dysplastic lesion types in novice and intermediate endoscopists compared with experienced endoscopists. The secondary aims were to assess the sustainability of the training effect

and confidence in the novice and intermediate endoscopists compared with experienced endoscopists.

METHODS

OPTIC-IBD is an international, multicenter study evaluating the effectiveness of targeted endoscopy training intervention. This involved (1) an IBD dysplasia training module for all participants and (2) focused training with feedback for a 1:1 randomized cohort (ClinicalTrials.gov: NCT04924543). The study flow is shown in Figure 1. OPTIC-IBD received research ethics committee approval from the University of Birmingham, United Kingdom (ERN18-022), and the University of Calgary, Canada (REB21-0409), with local approval at Italian centers (June 2021). All participants gave informed electronic consent. The study was sponsored by the University of Birmingham and supported by a grant from GutsUK (TRN2019-03).

Participants

Study participants were recruited from Calgary (Canada), Bari, Milan, Naples (Italy), the West Midlands, and nationwide in the United Kingdom. Participants included gastroenterologists performing endoscopy in training programs, independent specialist physicians, surgeons, and nonmedical staff performing endoscopy. Participants were grouped a priori into novice endoscopists (<100 lifetime colonoscopies) with no previous exposure bias to endoscopy training or practice, intermediate endoscopists (100-1000 lifetime colonoscopies), and experienced endoscopists (>1000 lifetime colonoscopies).

In addition, we invited an international panel of expert endoscopists in optical diagnosis and IBD. Experts were defined as specialists with at least 10 years in independent practice, at least 2000 lifetime colonoscopies, and at least 100 lifetime DCEs or VCEs (J.G.P.F., M.I., R.K., A.P.-B., G.E.T., T.U.). A subgroup of the experienced participants also met these criteria, acting as a further positive control group.

Training module

An expert group designed a self-directed, multimodality online training module (Fig. 2). This included learning objectives, background, and principles of IBD surveillance, advantages of optical enhancement tools in virtual chromoendoscopy, lesion characterization and classification systems (Five S,[17] SCENIC recommendations including modified Paris,[5] modified Kudo,[13,14] FACILE[16]) (see Appendix 1, available online at www.giejournal.org), worked example questions with multiple images and videos, and self-assessment questions. All training images were produced/redrawn for the training module to increase learning or adapted/reproduced with permission from the original publisher; for teaching purposes, some images were edited with arrows or lines to mark relevant features. However, they were only used as examples in the training module as animated features and not used in the evaluation sets. Moreover, we asked participants to provide quantitative and qualitative feedback on the training module and the focused training.

Video library

All endoscopic IBD colonic lesion videos used in the online training module and assessments were anonymized and recorded with the patient's consent for clinical education. All videos started with an initial assessment with high-definition white-light endoscopy (WLE-HD) after DCE and VCE. In all videos, virtual chromoendoscopy was performed to accurately characterize endoscopic features of colonic IBD lesions. Overall, 32 videos were used. Of them, 24 were used for the first validation phase (whole cohort) and 20 for the second validation phase (sustainability cohort), for which 8 new videos were included (15 videos with iSCAN [Pentax], 15 videos with Narrow-Band Imaging [Olympus], and 2 videos with Linked Color Imaging/Blue Light Imaging [Fujifilm]).

We included 12 nondysplastic lesions (4 pseudopolyps/inflammatory, 4 hyperplastic [HP], 4 sessile serrated lesions [SSLs]) and 20 dysplastic lesions (13 low-grade dysplasia [LGD] and 7 high-grade dysplasia [HGD] or invasive carcinoma). SSLs with dysplastic components were included under LGD. The reference standard to determine the correct optical diagnosis was the histopathologic assessment by expert GI pathologists. In the case of LGD, we asked for a second opinion from another expert pathologist.

Lesions were characterized according to the SCENIC classification[5] (modified Paris descriptors, border, ulceration), modified Kudo classification[13,14] (including II-O pit pattern), and FACILE classification[16] (morphology, surface architecture, vessel architecture, inflammation) (Appendix 1). The reference standard was based on consensus from the 6 international experts who supervised the study (M.I., R.K., A.P.B., G.E.T., T.U., J.F.). All the experts agreed on the video and picture pool, and their quality was initially selected by M.I. T.P., and R.I., who assessed the aforementioned classifications. The raters assessed the pictures and videos according to the classification (Appendix 1), and they predicted histology.

Interventions and randomization

On study day 7, all participants received instructions on using the study intervention, the online OPTIC-IBD training module, which they accessed at their own time and pace.

The first validation phase compared diagnostic performance between precourse (T0) and postcourse (T1) assessments. Participants were also randomly selected to receive or not receive our additional study intervention (focused training with feedback), delivered 14 days after completing the postcourse (T1) assessment. Feedback was given after each assessment to increase confidence.

The second validation phase assessed long-term learning posttraining (T2) at 60 days. Randomization was 1:1, unblinded, and stratified by country of clinical practice using

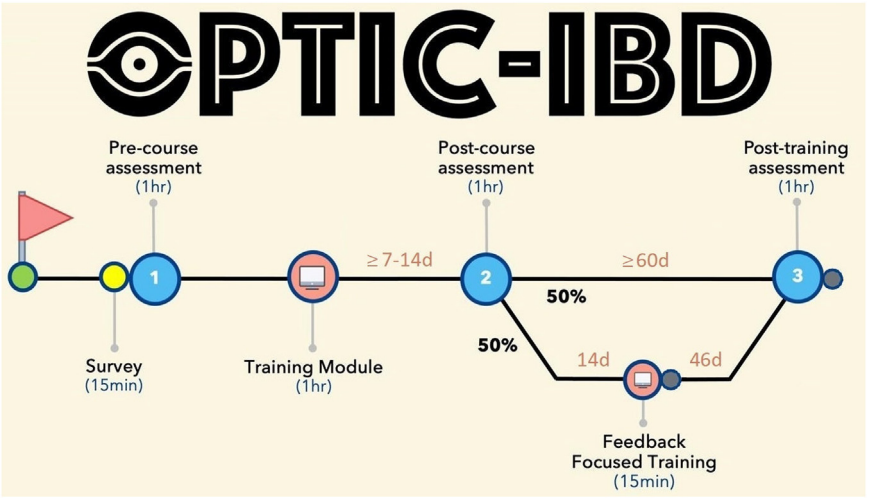


Figure 1. The OPtical diagnosis Training to Improve dysplasia Characterization in Inflammatory Bowel Disease (OPTIC-IBD) study design. In addition to an initial survey (*yellow circle*), there were 3 assessments with endoscopic videos (*blue circles*: 1, precourse (T0) at baseline; 2, postcourse (T1) at least 7 days from precourse; and 3, posttraining (T2) at least 60 days from postcourse). There were 2 online training interventions (*red circles*): a training module received by all participants on study day 7 and brief focused training with feedback received by half the participants (randomized 1:1 and stratified by country of practice) on day 14 after the postcourse assessment. This feedback provided the correct optical diagnoses with participant answers for half of the videos in the precourse and postcourse assessments (T0 and T1, respectively). These videos were not used in the posttraining (T2) assessment. Feedback on all endoscopic videos was provided to all participants who completed the study (*gray circle*).

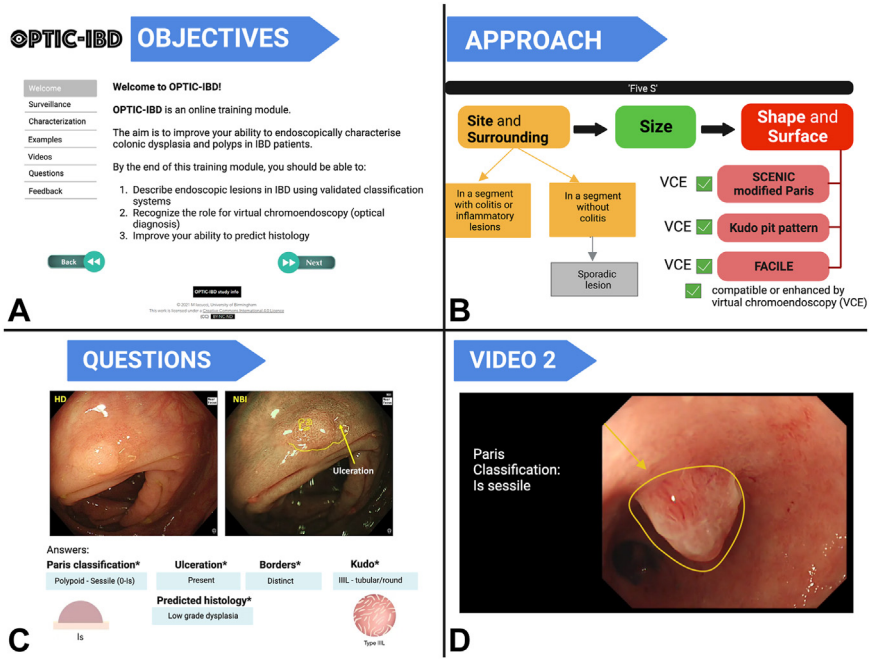


Figure 2. Some slides from the OPTIC-IBD online training module. **A,** The objectives of the online training module. **B,** The approach to a colonic lesion—in particular, describe the site, surrounding area, size, shape, and surface. **C,** An example of a question about to a colonic lesion: each participant was asked to define the modified Paris classification and Kudo pit pattern and to predict histology. **D,** An example of a video shown in the training module: each video explained to participants how to characterize a colonic lesion with help from shapes and arrows. Created with Biorender.com.

an external allocation grid with a block size of 4. The focused training recapped information on the endoscopic classification systems to reinforce the features of each lesion type. The feedback provided the correct optical diagnoses with participant answers for a randomized subset of 12 videos used in precourse and postcourse assessments and 8 new videos, stratified by lesion type.

The control group did not receive focused training and continued the study until the long-term posttraining (T2) assessment (after 60 days). Feedback on all the endoscopic

videos was provided to all participants who completed the study 6 weeks after the posttraining (T2) assessment.

Survey and video assessments

All participants and invited experts completed an initial survey at baseline. This survey collected data on basic demographics, country of clinical practice, training status and specialty, time in training or independent practice, colonoscopy experience, and experience with IBD surveillance.

All participants were asked to complete the same precourse (T0), postcourse (T1), and posttraining (T2) assessments. These were completed at baseline, after days 7 to 14, and after 60 days from the postcourse (T1) assessment.

Participants were asked to grade their baseline confidence in IBD-associated lesion characterization (7-step Likert scale from no confidence to high confidence) and, for each lesion, the video quality (high or low), endoscopic classifications (SCENIC, Kudo, and FACILE), overall optical diagnosis, and confidence in their prediction (high or low).

The course assessment comprised 24 videos, 8 with nondysplastic and 16 with dysplastic lesions (3 inflammatory, 2 HP, 3 SSLs, 12 LGD, 4 HGD/cancer). The same 24 videos in the precourse and postcourse assessments were randomized and assessed after a minimum of 7 to 14 days to reduce recall bias.

After 60 days, all participants, regardless of randomization, were invited to the long-term posttraining (T2) assessment to measure the sustainability of the training interventions, including any additional impact of the focused training with feedback. The feedback was about a randomized subset of half of the 24 videos. Therefore, the postcourse assessment included 20 videos (3 inflammatory, 3 HP, 2 SSLs, 9 LGD, 3 HGD/cancer), 8 new and 12 of the initial videos not used in the feedback.

Outcome measures

The primary outcome measure was the impact of the OPTIC-IBD training module on the diagnostic accuracy (including sensitivity and specificity) of optical diagnosis for dysplastic lesion types between the precourse (T0) and postcourse (T1) assessments among novice, intermediate, and experienced endoscopists.

The secondary outcome was to assess the sustainability of training over a longer period (at least 2 months), a surrogate measure to estimate the lasting effect of the course. In detail, we compared the accuracy of optical diagnosis between the precourse (T0), postcourse (T1), and long-term posttraining (T2) assessments. For the additional randomized intervention of focused training with feedback, we compared the performance of the intervention and control groups.

The tertiary outcome was to investigate participants' confidence in characterizing lesion between precourse and postcourse and in the sustainability cohort, focusing mainly on the possible differences between novice, intermediate, and experienced endoscopists.

Statistical analysis

Study data were collected and managed using the Research Electronic Data Capture (REDCap) data capture tool, a secure, web-based platform hosted at the University of Birmingham.

Accuracy, sensitivity, specificity, and confidence (Likert scale) were summarized with median and interquartile range (IQR).

Continuous variables were compared with the nonparametric Wilcoxon matched-pairs signed rank test or the 2-sample Wilcoxon rank sum (Mann-Whitney *U*) test, as appropriate. The number of participants was calculated based on the primary endpoint (change of diagnostic accuracy in characterizing dysplastic lesions after training on the platform). We estimated that 128 participants were needed to provide a power of 80% to detect a change of 5% between the precourse and postcourse assessments, assuming the standard deviation of the change to be 20% ($\alpha = .05$, 2-sided). To account for potential dropouts, we increased the sample size (by 40%) to 180 participants. As for the number of educational videos, practical considerations such as time and cost were considered.

Statistical analysis was completed in SPSS (SPSS Inc, Chicago, Ill, USA). A 2-sided *P* value of $< .05$ was considered statistically significant.

RESULTS

Participants

Participant characteristics are shown in Table 1. Overall, 182 individuals consented to participate in OPTIC-IBD. A total of 33 (18%) and 32 (18%) did not complete the precourse (T0) and postcourse (T1) assessments, respectively, and were withdrawn. There were 117 participants in the primary endpoint cohort who had completed the training module and the initial assessments. Of these, 42 (36%; 23% overall) did not complete the final posttraining (T2) assessment. The median time between the first assessments was 21 days (IQR, 17-65).

Most participants were trainees (65.8%), and 70.9% were less experienced endoscopists (novice [35.0%] and intermediate [35.9%]).

There were 75 participants in the sustainability cohort, having completed all phases of the study protocol, including those randomized to brief focused training with feedback (intervention, 33 [44%] participants; control, 42 [56%] participants). The median time from the postcourse (T1) to the posttraining (T2) assessment was 10 weeks (69 days; IQR, 65-75), and 70.7% and 72% were trainee and less experienced endoscopists, respectively.

First validation phase (whole cohort)

A total of 117 participants completed the first validation phase.

TABLE 1. Participant characteristics

Participants' groups	Primary endpoint cohort (T1)	Sustainability cohort (T2)		
		Overall	Intervention	Control
Total participants	117	75	33	42
Female	55 (47.0)	34 (45.3)	16 (48.5)	18 (42.8)
Age, y				
25-34	66 (56.4)	43 (57.3)	17 (51.5)	26 (61.9)
35-44	36 (30.8)	23 (30.7)	10 (30.3)	13 (31.0)
45-54	8 (6.8)	2 (2.7)	1 (3.0)	1 (2.4)
≥55	7 (6.0)	7 (9.3)	5 (15.2)	2 (4.8)
Country of clinical practice				
Canada	13 (11.1)	6 (8.0)	2 (6.1)	4 (9.5)
Italy	51 (43.6)	35 (46.7)	15 (45.5)	20 (47.6)
United Kingdom	53 (45.3)	34 (45.3)	16 (48.5)	18 (42.9)
Training status				
Trainee	77 (65.8)	53 (70.7)	21 (63.6)	32 (76.2)
Independent	40 (34.2)	22 (29.3)	12 (36.4)	10 (23.8)
Endoscopic experience level				
Novice	41 (35.0)	29 (38.7)	10 (30.3)	19 (45.2)
Intermediate	42 (35.9)	25 (33.3)	12 (36.4)	13 (31.0)
Experienced	34 (29.1)	21 (28.0)	11 (33.3)	10 (23.8)

Values are n or n (%).

Diagnostic performance in the primary endpoint cohort and the impact of the training module on the accuracy, sensitivity, and specificity for dysplasia characterization in IBD colonic lesion are shown in Table 2.

Diagnostic accuracy improved significantly from the precourse (T0) to the postcourse (T1) (from 70.8% [IQR, 58.3-79.2] to 75.0% [IQR, 64.6-79.2]; $P = .002$).

Although the sensitivity for dysplasia remained stable, there was a significant increase in specificity (from 62.5% [IQR, 50.0-75.0] to 75.0% [IQR, 62.5-87.5]; $P < .001$).

Subgroup analyses

A significant improvement of diagnostic accuracy was noted in less experienced endoscopists (novice: 62.5% [IQR, 54.2-66.7] to 66.7% [IQR, 58.3-72.9]; $P = .041$; intermediate: 70.8% [IQR, 61.5-76.0] to 75.0% [IQR, 66.7-79.2]; $P = .032$). Improvements were attributable to an increase in specificity. As an aspirational target and control, the group-invited experts achieved overall accuracy, sensitivity, and specificity of 85.4% (IQR, 78.1-92.7), 88.2% (IQR, 77.9-95.6), and 78.6% (IQR, 71.4-100), respectively, with a similar performance by expert participants.

There was an improvement in diagnostic accuracy, sensitivity, and specificity when considering participants of all countries. Accuracy increased in particular among U.K. participants (from 66.7% [IQR, 56.3-77.1] to 70.1% [IQR, 62.5-79.2]; $P = .002$), and specificity increased especially in Canada (from 62.5% [IQR, 56.3-75.0] to 75.0% [IQR, 75.0-93.8]; $P = .016$) and U.K. participants (from 62.5% [IQR, 50.0-87.5] to 75.0% [IQR, 62.5-87.5]; $P = .002$).

Confidence in histologic prediction

There was an increase in participants' confidence in correctly characterizing IBD-associated lesions.

A median of 8 (IQR, 1-13) and 12 (IQR, 4-17) videos were rated as being at high confidence during the precourse (T0) and postcourse (T1) assessments, respectively.

According to the 7-point Likert scale, the confidence in histologic prediction significantly increased overall and in trainees, independent endoscopists, and less experienced endoscopists (Supplementary Table 1, available online at www.giejournal.org).

Second validation phase (sustainability cohort)

A total of 75 participants completed the sustainability phase.

Diagnostic performance in the sustainability cohort and the impact of randomized focused training with feedback comparing the intervention and control group are shown in Table 3.

Improvements in diagnostic accuracy for dysplasia were sustained at least 2 months to the final posttraining (T2) assessment (precourse [T0], 66.7% (IQR, 58.3-75.0); postcourse [T1], 70.8% (IQR, 60.0-79.2); and posttraining [T2], 70.0% (IQR ,60.0-80.0); T0 vs T2: $P = .014$).

TABLE 2. Diagnostic performance in the primary endpoint cohort and impact of the training module on the accuracy, sensitivity, and specificity for dysplasia in IBD colonic lesions

Participants' groups	n	Accuracy for dysplasia			Sensitivity for dysplasia			Specificity for dysplasia		
		Precourse (T0)	Postcourse (T1)	*P* value	Precourse (T0)	Postcourse (T1)	*P* value	Precourse (T0)	Postcourse (T1)	*P* value
Overall	117	70.8 (58.3-79.2)	75.0 (64.6-79.2)	.002	75.0 (59.4-81.3)	75.0 (62.5-81.3)	.38	62.5 (50.0-75.0)	75.0 (62.5-87.5)	<.001
Confidence in diagnosis										
High	*	75.0 (66.7-79.2)	75.0 (66.7-83.3)	.71	75.0 (68.8-87.5)	81.3 (62.5-87.5)	.79	75.0 (62.5-87.5)	75.0 (62.5-81.3)	.72
Low	*	64.6 (54.2-75.0)	70.8 (58.3-75.0)	.28	68.8 (50.0-81.3)	68.8 (54.2-75.0)	.75	62.5 (46.9-75.0)	75.0 (50.0-75.0)	.018
Country of clinical practice										
Canada	13	75.0 (66.7-79.2)	75.0 (68.8-85.4)	.10	81.3 (68.8-81.3)	81.3 (71.9-87.5)	.50	62.5 (56.3-75.0)	75.0 (75.0-93.8)	.016
Italy	51	70.8 (62.5-79.2)	75.0 (62.5-79.2)	.66	75.0 (62.5-87.5)	75.0 (62.5-87.5)	.83	62.5 (50.0-75.0)	62.5 (50.0-75.0)	.39
United Kingdom	53	66.7 (56.3-77.1)	70.1 (62.5-79.2)	.002	68.8 (50.0-81.3)	68.8 (62.5-81.3)	.31	62.5 (50.0-87.5)	75.0 (62.5-87.5)	.002
Training status										
Trainee	77	66.7 (58.3-75.0)	66.7 (62.5-75.0)	.009	68.8 (56.3-81.3)	68.8 (62.5-81.3)	.29	62.5 (50.0-75.0)	75.0 (50.0-75.0)	.027
Independent	40	77.1 (70.8-83.3)	79.2 (71.9-86.5)	.076	81.3 (75.0-93.8)	81.3 (75.0-87.5)	.87	62.5 (53.3-75.0)	75.0 (62.5-87.5)	.004
Endoscopic experience level										
Novice	41	62.5 (54.2-66.7)	66.7 (58.3-72.9)	.041	68.8 (46.9-81.3)	68.8 (56.3-81.3)	.20	62.5 (50.0-75.0)	62.5 (54.2-66.7)	.16
Intermediate	42	70.8 (61.5-76.0)	75.0 (66.7-79.2)	.032	71.9 (60.1-81.3)	68.8 (62.5-81.3)	.68	62.5 (50.0-75.0)	75.0 (62.5-87.5)	.010
Experienced	34	79.2 (70.8-83.3)	79.2 (74.0-87.5)	.37	81.3 (75.0-93.8)	81.3 (75.0-87.5)	.27	62.5 (59.4-75.0)	75.0 (62.5-90.6)	.035
Expert group										
Participants	5	87.5 (77.1-95.8)	91.7 (85.4-93.8)	.46	93.8 (87.5-93.8)	87.5 (87.5-93.8)	.71	75.0 (56.3-100)	100 (75.0-100)	.18
Invited	6	85.4 (78.1-92.7)		N/A	88.2 (77.9-95.6)		N/A	78.6 (71.4-100)		N/A

Values are median (interquartile range) unless noted otherwise. Comparisons were performed using the Wilcoxon matched-pairs signed rank test.
IBD, Inflammatory bowel disease; *N/A*, not applicable.
*Precourse, a median of 8 of 24 videos were rated as high confidence (IQR, 1-13) and postcourse, 12 of 24 (IQR, 4-17). Precourse, a median of 16 of 24 videos were rated as low confidence (IQR, 11-23) and postcourse, 12 of 24 (IQR, 7-20).

Subgroup analyses

Improvement in accuracy was sustained in all groups except for novice (from 62.5% [IQR, 54.2-66.7] at T0 to 66.7% [IQR, 60.4-70.8] at T1 to 60.0 [IQR, 50.0-72.5] at T2; T0 vs T2: $P = .010$).

There was an improvement in diagnostic accuracy in all country participants, which was sustained for Canada and the United Kingdom but not for Italy (from 66.7% [IQR, 62.5-75.0] at T0 to 70.8 [IQR, 66.7-79.2] at T1 to 65.0 [IQR, 55.0-75.0] at T2).

Confidence in histologic prediction

Participants' confidence in correctly characterizing IBD-associated lesions increased significantly.

A median of 7 (IQR, 2-13), 11 (IQR, 5-17), and 10 (IQR, 4-14) videos were rated as being at high confidence during precourse (T0), postcourse (T1), and posttraining (T2) assessments, respectively. According to 7-point Likert scale, the confidence in histologic prediction significantly increased overall and in all groups, except for the expert group. Confidence was maintained in the posttraining phase (Supplementary Table 2, available online at www.giejournal.org).

Differences between the intervention and control groups

Among the 75 participants of the sustainability cohort, 33 (44%) were randomized to receive additional focused training intervention with feedback, and 42 (56%) represented the control group.

There was no significant difference in overall and subgroup diagnostic accuracy between the intervention and control groups (Table 3). However, the randomization was not stratified by endoscopic experience, so the control group included a slightly higher proportion of novice (35.0% vs 38.7%) and intermediate endoscopists (35.9% vs 33.3%) than the intervention group. In addition, there was a higher dropout rate among participants randomized to the intervention group.

Confidence in histologic prediction did not differ significantly between the 2 groups, except for an increase among independent and experienced endoscopists in the

TABLE 3. Diagnostic performance (accuracy) in the sustainability cohort and the impact of randomized focused training with feedback comparing the intervention and control groups

		Accuracy of optical diagnosis for dysplasia								
					P value		Posttraining (T2) by randomized group			
Participants' groups	n	Precourse (T0)	Postcourse (T1)	Posttraining (T2)	T0 vs T2	T1 vs T2	n	Intervention	n	Control	*P* value
Overall	75	66.7 (58.3-75.0)	70.8 (60.0-79.2)	70.0 (60.0-80.0)	.014	.47	33	70.0 (60.0-80.0)	42	70.0 (60.0-80.0)	.97
Confidence in diagnosis											
High	*	65.0 (60.0-75.0)	75.0 (66.7-83.3)	75.0 (65.0-80.0)	.011	.77	†	75.0 (65.0-82.5)	†	80.0 (70.0-80.0)	.69
Low	*	62.5 (54.2-70.8)	70.8 (58.3-75.0)	70.8 (55.0-75.0)	.022	.62	†	62.5 (48.8-75.0)	†	60.0 (55.0-72.5)	.64
Country of clinical practice											
Canada	6	72.9 (60.4-79.2)	75.0 (64.6-83.3)	75.0 (65.0-82.5)	.60	.92	2	72.5 (65.0-80.0)	4	75.0 (66.3-87.5)	.80
Italy	35	66.7 (62.5-75.0)	70.8 (66.7-79.2)	65.0 (55.0-75.0)	.69	.018	15	65.0 (60.0-80.0)	20	67.5 (55.0-75.0)	.54
United Kingdom	34	66.7 (57.3-79.2)	68.8 (62.5-79.2)	72.5 (60.0-80.0)	.24	.22	16	72.5 (56.3-80.0)	18	72.5 (60.0-81.3)	.72
Training status											
Trainee	53	62.5 (58.3-75.0)	66.7 (62.5-75.0)	65.0 (55.0-75.0)	.70	.028	21	65.0 (57.5-75.0)	32	65.0 (55.0-75.0)	.83
Independent	22	77.1 (69.8-80.2)	81.2 (70.8-87.5)	80.0 (73.8-85.0)	.49	.34	12	77.5 (66.3-80.0)	10	80.0 (80.0-86.3)	.14
Endoscopic experience level											
Novice	29	62.5 (54.2-66.7)	66.7 (60.4-70.8)	60.0 (50.0-72.5)	.99	.010	10	60.0 (43.0-75.0)	19	60.0 (55.0-70.0)	.81
Intermediate	25	66.7 (62.5-77.1)	70.8 (66.7-79.2)	70.0 (65.0-80.0)	.37	.64	12	65.0 (61.3-78.8)	13	70.0 (65.0-80.0)	.61
Experienced	21	75.0 (70.8-81.3)	79.2 (72.9-87.5)	80.0 (72.5-85.0)	.78	.40	11	80.0 (70.0-85.0)	10	80.0 (76.3-86.3)	.65
Expert group											
Participants	4	87.5 (76.0-95.8)	91.7 (85.4-94.8)	85.0 (76.3-90.0)	.59	.07	2	82.5 (75.0-90.0)	2	85.0 (80.0-90.0)	.67
Invited	6	85.4 (78.1-92.7)	N/A	80.0 (76.3-88.8)	N/A	N/A	N/A				

Values are median (interquartile range) unless noted otherwise. Comparisons were performed using the Wilcoxon matched-pairs signed rank test and the 2-sample Wilcoxon rank sum (Mann-Whitney) test.

N/A, Not applicable.

*Precourse, a median of 7 of 24 videos were rated as high confidence (IQR, 2-13); postcourse, 11 of 24 (IQR, 5-17); and posttraining, 10 of 20 (IQR, 4-14). Precourse, a median of 17 of 24 videos were rated as low confidence (IQR, 11-23); postcourse, 13 of 24 (IQR, 7-20); and posttraining, 10 of 20 (IQR, 6-16).

†In the intervention group, a median of 11 of 20 videos were rated as high confidence (IQR, 3-16) and in the control group, 8 of 20 (IQR, 4–13). In the intervention group, a median of 9 of 20 videos were rated as low confidence (IQR, 4-17) and in the control group, 13 of 20 (IQR, 7-16).

intervention group (4 [IQR, 4-5] vs 3 [IQR, 3-3]; $P = .004$ and 4 [IQR, 4-5] vs 3 [IQR, 3-3]; $P = .006$, respectively) (Supplementary Table 2).

Interobserver agreement was fair, with the Fleiss kappa ranging from 0.23 (95% confidence interval [CI], 0.10-0.35) before the training course to 0.24 (95% CI, 0.12-0.37) after the course. The Fleiss kappa agreement was moderate or substantial for the experienced/expert endoscopists, ranging from 0.54 (95% CI, 0.41-0.66) before the training course to 0.68 (95% CI, 0.55-0.80).

Feedback from participants

Most participants found the TRAINING MODULE to be effective (90.9% agree or strongly agree) and relevant (94.7%) and would recommend it (91.0%). Roughly half of the respondents provided additional feedback; among the most appreciated features were the wealth of visual (image/video) content and the ability to self-assess; consistently, the most common suggestion for improvement was to increase the number of examples and questions. Among those randomized to focused training, more than three-quarters thought it was relevant and helpful in consolidating knowledge, and all respondents recommended including refresher training in the course. Additional feedback was provided by around a third of the participants, who appreciated the concise format and focused topics and recommended more self-assessment examples.

DISCUSSION

Performing endoscopy in patients with IBD requires a subset of endoscopic skills and advanced knowledge rarely acquired in core gastroenterology training. Currently, in the absence of standard curricula, acquiring the necessary

skills and knowledge relies on local expertise and/or dedicated postgraduate courses.[18] This variation often results in gaps and heterogeneity of needed competence. Clinically, this leads to misclassification of nondysplastic lesions as dysplastic and a low interobserver agreement for lesion histopathology prediction, which can result in significant consequences for patients.[19] Often, the opportunity to have enough experience in the detection and characterization of dysplastic lesions in IBD and to distinguish them from nonneoplastic lesions is limited. Hence, the need for new training avenues in IBD optical diagnosis is crucial.

Web-based education represents a valuable tool for filling the gap. This type of instructions has been successfully used in the characterization of sporadic lesions.[20-22] The OPTIC-IBD training module was designed as a comprehensive training platform to track the key principles needed for competency in the optical diagnosis in IBD lesion characterization and provide enough examples and self-assessment, all in a practical form. It can be completed in a short amount of time, with most participants completing the module in 1 hour.

In this prospective multicenter international study, we demonstrated how participation in the web-based course OPTIC-IBD led to significant improvement in the diagnostic accuracy of lesion type and specificity of dysplasia detection in IBD-associated colorectal lesions. Training increased overall accuracy from 70.8% to 75.0% ($P = .002$) and specificity from 62.5% to 75.0% ($P < .001$), with benefits particularly evident among less experienced endoscopists. Such benefits may be of value to improve surveillance colonoscopy skills in IBD.

The primary analysis focused on recognizing and distinguishing between dysplastic and nondysplastic lesions. As a secondary analysis, we looked at confidence in diagnosis, which correlates with clinical decision-making. Predictably, confidence significantly increased in all groups.

The course improvements were sustained over time in almost all groups and were not significantly influenced by receiving or not receiving additional refresher training. Hence, the initial course (T0-T1) resulted in a lasting benefit for participants, whereas gains from refresher training (T2) appeared modest.

This might be related to the nature of the training. In fact, the key principles of optical diagnosis are easily remembered once a framework for assessment (for example, Five S) is provided. We believe the main teaching of the course is the methodologic approach to lesions, which stands the test of time better than other approaches. In addition, using animation for training contributes significantly to strengthening learning and keeping it simple and effective.

Despite general improvement, benefits could not be maintained in some trainees and novice endoscopists, suggesting that further training or additional videos may be needed in this subset of participants. No formal maintaining competence in the optical diagnosis of IBD dysplasia data is currently available. Further studies should be conducted to clarify if annual sustainability refresher courses may be needed to maintain competencies.

The interobserver agreement between raters was fair before and after the training course. In contrast, it was moderate or substantial for the experienced/expert endoscopists. This was rather expected because of the participants' diverse backgrounds and varying levels of experience, which could have influenced their interpretations.

Overall, OPTIC-IBD was evaluated as effective, relevant, and recommended by nearly all the participants. Respondents appreciated its image-based teaching and the presence of concise and focused topics. Although a longer course might have further improved performance, we limited the length so as not to overwhelm trainees and lose engagement. A positive reception is fundamental to ensuring a successful rollout. The feasibility of OPTIC-IBD was tested by its launch on the European Crohn's Colitis Organisation platform. This was enthusiastically received, and we are optimistic that the OPTIC-IBD system can be disseminated through other gastroenterology societies and, furthermore, in clinical practice without a specific purchase fee.

A major strength of the present study is its multicenter, randomized design. This provided a large sample size compared to other studies and allowed for some subgroup analysis.

Moreover, enrolling participants across 3 countries and multiple institutions mitigated selection bias and increased generalizability of the results. Furthermore, the randomization in different groups provides robust evidence that additional training did not further improve results. To the best of our knowledge, this represents the first published training model for a colorectal lesion in IBD to date. Only a few studies have focused on disease assessment[18] and none on dysplasia/nondysplasia characterization. As treatment for IBD improves, colectomy rates decrease, and the population ages, the share of patients with "long-standing" disease will increase, and so will the importance of surveillance quality.

Despite all the positive feedback, our study has some limitations. First, assessments were limited to videos on lesions characterization and did not cover decision-making skills—for example, the management plan for polyps—which are important in daily practice. Second, because the assessments were self-administered, cheating cannot be excluded. However, none of the images or videos were publicly available, limiting the hints found on the Internet. Obviously, voluntary participation and withdrawal could have skewed selection toward more motivated participants, but this was unavoidable. Timing intervals were chosen arbitrarily and might not be adequate to detect information retention. Finally, the efficacy of training interventions relies on their design, content, and application of learning theory. This could explain the lack of benefit seen with refresher

training, which can be improved in future iterations of OPTIC-IBD.

The advent of artificial intelligence could help improve the characterization of IBD lesions. However, this will not replace the need for training because only an endoscopist competent in optical diagnosis will have sufficient confidence to rely on artificial intelligence characterization.

CONCLUSION

We propose OPTIC-IBD as a basis for future IBD endoscopy educational initiatives under the patronage of gastroenterology societies. We pledge to make it available immediately, free of charge, and open for the improvement of competencies for trainees and gastroenterologists. With this interactive training module, we seek to offer a first tool to disseminate knowledge on IBD endoscopy, which should be included in the IBD curriculum and ideally be followed by hands-on practice in specialized centers. Furthermore, optimizing report quality and concurrent aligned training curricula are warranted in designing new training modules in IBD endoscopy to promote standardization and the dissemination of common language among gastroenterologists to drive better patient outcomes.

In conclusion, OPTIC-IBD, a self-directed, web-based training module, effectively augments optical diagnosis and dysplasia characterization in IBD, particularly among trainees.

DISCLOSURE

All authors disclosed no financial relationships. The study was supported by a grant from GutsUK (TRN2019-03).

ACKNOWLEDGMENTS

Data are available on request.

The OPTIC-IBD Study Group includes Abdullah Abbasi, Adele Wargen, Ahmed Feroz, Alessandra Dell'Era, Alessandra Piagnani, Alessandro Rimondi, Alessia Chini, Alessia D. Guarino, Alessia Todeschini, Amar Srinivasa, Andrea Sorge, Angelica Toppeta, Anna M. C. Gabrielli, Anna Testa, Anthony MacLean, Antonella Contaldo, Antonia Churchhouse, Anupama De Silva, Beatrice Marinoni, Chiara Lillo, Christopher N. Andrews, Ciro Lentano, Costantino Sgamato, Daniele Gridavilla, Daniele Noviello, Danny Cheung, Dhanai Di Paolo, Domenico Novielli, Dominic King, Edoardo Borsotti, Eleanor Liu, Elena Arsiè, Elisa Farina, Elisabetta Filippi, Emanuele Annoscia, Fabiana Castiglione, Fenella Marley, Francesca Ferretti, Francesco Conforti, Francis Egbuonu, Fulvio S. D'Abramo, Giulia Scardino, Giuseppe Indellicati, Giuseppe Losurdo, Antonietta Gerarda Gravina, Ian Beales, Ibrahim Al Bakir, Ilaria Ditonno, Imma Di Luna, Imran Tahir, Irene Bergns, Irene V. Brescia, Isabel Carbery, Ismaeel Al-Talib, Jawad Azhar, Jeffrey Butterworth, Joel James, Joëlle St-Pierre, John Jacob, Jordan Iannuzzi, Katharine Todd, Kelly Chatten, Leah Gilroy, Lekshmy S. Pillai, Luca Pastorelli, Lucienne Pellegrini, Lushen Pillay, Marco Romano, Maria C. Monico, Mariapaola Piazzolla, Marius Paraoan, Marta Patturelli, Martino Mezzapesa, Matthew Woo, Maxime Delisle, Melissa Chan, Michael Gomez, Michael Z. Ma, Milli Gupta, Misha Kabir, Mohammad F. Khattak, Mohit Inani, Muaad Abdulla, Muhammad Saad, Munaa Khaliq-Kareemi, Nauman Idrees, Nick Burr, Nicola Henderson, Nurulamin Noor, Odhran Doherty, Oliver Bendall, Oriana Olmo, Philip Harvey, Philip Oppong, Puja Kumar, Rachid Mohamed, Rahman H. M. Abdul, Rebecca Carruthers, Rebecca O'Kane, Roberto de Sire, Salvatore Rizzi, Samantha Horley, Sarah Al-Shakhshir, Sarah Townsend, Sherif Abdelbadiee, Sofia Ridolfo, Sonika Sethi, Stefania De Lisi, Stefania Marangi, Tim Ambrose, Tom Troth, Vincenzo Occhipinti, Wai L. Lam, Yasmin Nasser, Zia Rahman. All study participants who completed the precourse and postcourse assessments are included with their consent as collaborators with the OPTIC-IBD Study Group.

REFERENCES

1. Jess T, Rungoe C, Peyrin-Biroulet L. Risk of colorectal cancer in patients with ulcerative colitis: a meta-analysis of population-based cohort studies. Clin Gastroenterol Hepatol 2012;10:639-45.
2. Magro F, Gionchetti P, Eliakim R, et al. Third European evidence-based consensus on diagnosis and management of ulcerative colitis. Part 1: definitions, diagnosis, extra-intestinal manifestations, pregnancy, cancer surveillance, surgery, and ileo-anal pouch disorders. J Crohns Colitis 2017;11:649-70.
3. Parigi TL, Nardone OM, Iacucci M. Image-enhanced endoscopy surveillance of colon and pouch dysplasia in IBD. Dis Colon Rectum 2022;65:S119-28.
4. Bisschops R, East JE, Hassan C, et al. Advanced imaging for detection and differentiation of colorectal neoplasia: European Society of Gastrointestinal Endoscopy (ESGE) guideline—update 2019. Endoscopy 2019;51:1155-79.
5. Laine L, Kaltenbach T, Barkun A, et al. SCENIC international consensus statement on surveillance and management of dysplasia in inflammatory bowel disease. Gastroenterology 2015;81:639-51.e628.
6. Iacucci M, Furfaro F, Matsumoto T, et al. Advanced endoscopic techniques in the assessment of inflammatory bowel disease: new technology, new era. Gut 2019;68:562-72.
7. Nardone OM, Cannatelli R, Ghosh S, et al. New endoscopic tools in inflammatory bowel disease. United European Gastroenterol J 2022;10:1103-12.
8. Nardone OM, Cannatelli R, Zardo D, et al. Can advanced endoscopic techniques for assessment of mucosal inflammation and healing approximate histology in inflammatory bowel disease? Therap Adv Gastroenterol 2019;12:1756284819863015.
9. Bisschops R, Bessissow T, Dekker E, et al. Pit pattern analysis with high-definition chromoendoscopy and narrow-band imaging for optical diagnosis of dysplasia in patients with ulcerative colitis. Gastrointest Endosc 2017;86:1100-6.e1101.
10. Vleugels JLA, Rutter MD, Ragunath K, et al. Diagnostic accuracy of endoscopic trimodal imaging and chromoendoscopy for lesion characterization in ulcerative colitis. J Crohns Colitis 2018;12:1438-47.

11. Dekker E, Houwen B, Puig I, et al. Curriculum for optical diagnosis training in Europe: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. Endoscopy 2020;52:C10.
12. Rutter MD, Saunders BP, Schofield G, et al. Pancolonic indigo carmine dye spraying for the detection of dysplasia in ulcerative colitis. Gut 2004;53:256-60.
13. Kudo S, Tamura S, Nakajima T, et al. Diagnosis of colorectal tumorous lesions by magnifying endoscopy. Gastrointest Endosc 1996;44:8-14.
14. Kimura T, Yamamoto E, Yamano HO, et al. A novel pit pattern identifies the precursor of colorectal cancer derived from sessile serrated adenoma. Am J Gastroenterol 2012;107:460-9.
15. Soons E, Bisseling TM, van der Post RS, et al. The Workgroup Serrated Polyps and Polyposis (WASP) classification for optical diagnosis of colorectal diminutive polyps with iScan and the impact of the revised World Health Organization (WHO) criteria. United European Gastroenterol J 2021;9:819-28.
16. Iacucci M, McQuaid K, Gui XS, et al. A multimodal (FACILE) classification for optical diagnosis of inflammatory bowel disease associated neoplasia. Endoscopy 2019;51:133-41.
17. Adamina M, Feakins R, Iacucci M, et al. ECCO topical review optimising reporting in surgery, endoscopy, and histopathology. J Crohns Colitis 2021;15:1089-105.
18. Daperno M, Comberlato M, Bossa F, et al. Training programs on endoscopic scoring systems for inflammatory bowel disease lead to a significant increase in interobserver agreement among community gastroenterologists. J Crohns Colitis 2017;11:556-61.
19. Vinsard DG, Bruining DH, East JE, et al. Interobserver agreement of modified Paris classification and histology prediction of colorectal lesions in patients with inflammatory bowel disease. Gastrointest Endosc 2023;97:790-8.e2.
20. Bouwens MW, de Ridder R, Masclee AA, et al. Optical diagnosis of colorectal polyps using high-definition i-scan: an educational experience. World J Gastroenterol 2013;19:4334-43.
21. Khan T, Cinnor B, Gupta N, et al. Didactic training vs. computer-based self-learning in the prediction of diminutive colon polyp histology by trainees: a randomized controlled study. Endoscopy 2017;49:1243-50.
22. Smith SCL, Saltzman J, Shivaji UN, et al. Randomized controlled study of the prediction of diminutive/small colorectal polyp histology using didactic versus computer-based self-learning module in gastroenterology trainees. Dig Endosc 2019;31:535-43.

Abbreviations: CI, confidence interval; DCE, dye chromoendoscopy; ESGE, European Society of Gastrointestinal Endoscopy; FACILE, Frankfurt Advanced Chromoendoscopic Inflammatory Bowel Disease Lesions Classification; HGD, high-grade dysplasia; HP, hyperplastic; IBD, inflammatory bowel disease; IQR, interquartile range; LGD, low-grade dysplasia; SCENIC, Surveillance for Colorectal Endoscopic Neoplasia Detection and Management in Inflammatory Bowel Disease Patients: International Consensus Recommendations; SSL, sessile serrated lesion; VCE, virtual chromoendoscopy.

Presented at European Crohn's Colitis Organization (ECCO), February 16-19, 2022, Virtual Congress: presented as Oral Presentation; European Society of Gastrointestinal Endoscopy (ESGE), April 28-30, 2022, Prague: presented as Oral Presentation; Digestive Disease Week (DDW) May 21-24, 2022, San Diego: presented as Poster; British Society of Gastroenterology (BSG) June 20-23, 2022 - Birmingham: presented as Poster.

0016-5107
https://doi.org/10.1016/j.gie.2023.11.018

Received May 21, 2023. Accepted November 13, 2023.

Current affiliation: University of Birmingham, Institute of Immunology and Immunotherapy, Birmingham, United Kingdom (1), College of Medicine and Health, University College Cork, Cork, Ireland (2), APC Microbiome Ireland, Cork, Ireland (3), Division of Gastroenterology and Hepatology, Cumming School of Medicine, University of Calgary, Calgary, Canada (4), Department of Biomedical Sciences, Humanitas University, Milan, Italy (5), IRCCS Humanitas Research Hospital, Milan, Italy (6), Forschungszentrum Jülich, Jülich Supercomputing Center, Jülich, Germany (7), Helmholtz AI, Oberschleißheim, Germany (8), Department of Biochemical and Clinical Sciences "L Sacco," University of Milan ASST Fatebenefratelli Sacco, Milano, Italy (9), National Institute of Gastroenterology, IRCSS "Saverio De Bellis," Castellana Grotte, Italy (10), Gastroenterology, Department of Public Health, University of Naples Federico II, Naples, Italy (11), Faculty of Medicine, University Vita-Salute San Raffaele, Milan, Italy (12), Department of Gastroenterology, Royal Cornwall Hospitals NHS Trust, Truro, United Kingdom (13), Department of Gastroenterology and Digestive Endoscopy, IRCCS San Raffaele Hospital, Milan Italy (14), Vita-Salute San Raffaele University, Milan, Italy (15), Helios Horst-Schmidt-Kliniken Hospital, Division of Gastroenterology, Wiesbaden, Germany (16), Department of Gastroenterology, Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom (17), Gastroenterology Unit, Department of Precision and Regenerative Medicine and Ionian Area (DiMePre-J), University of Bari, Bari, Italy (18), Department of Pathophysiology and Organ Transplantation, University of Milan, Milan, Italy (19), Gastroenterology and Digestive Endoscopy Unit, Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico, Milan, Italy (20), Department of Gastroenterology and Hepatology, Gunma University Graduate School of Medicine, Maebashi, Japan (21).

Reprint requests: Marietta Iacucci, MD, PhD, FASGE, AGAF, Clinical Science Building, UCC Department of Medicine, Cork University Hospital, University College Cork, T12 EC8P, Cork, Ireland. E-mails: Mlacucci@ucc.ie or iacuccim@yahoo.it.

SUPPLEMENTARY TABLE 1. Participants' confidence in correctly characterizing IBD-associated lesions

Participants' groups	n	Precourse (T0)	Postcourse (T1)	*P* value
		Participant self-ratings overall, median (IQR)		
	117	2 (1-3)	3 (2-4)	<.001
Training status				
Trainee	77	1 (0-3)	3 (2-3)	<.001
Independent	40	3 (2-4)	4 (3-4)	.001
Participant self-ratings by endoscopic experience level				
Novice	41	1 (0-1)	2 (1-3)	<.001
Intermediate	42	2 (2-3)	3 (3-4)	<.001
Experienced	34	3 (2-4)	3 (3-4)	.004
Expert group: participants	5	5 (4-5)	4 (3.5-5.5)	.56
Expert group: invited	6	5 (3.75-5)		

Comparisons were performed using the Wilcoxon matched-pairs signed rank test.
IBD, Inflammatory bowel disease; *IQR*, interquartile range; *N/A*, not applicable.

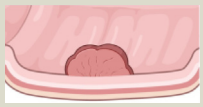
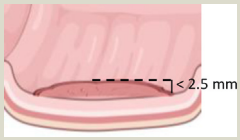
SUPPLEMENTARY TABLE 2. Participant confidence in correctly characterizing IBD-associated lesions (sustainability cohort)

		Participant self-ratings overall								
		Precourse	Postcourse	Posttraining	*P* value		Posttraining (T2) by randomized group			
	n	(T0)	(T1)	(T2)	T0 vs T2	T1 vs T2	n	Intervention	n	Control	*P* value
Overall	75	2 (1-3)	3 (2-4)	3 (2-4)	<.001	.58	33	3 (2.5-4)	42	3 (2-3)	.08
Training status											
Trainee	53	1 (0-3)	3 (2-3)	3 (2-3)	<.001	.36	21	3 (2-3)	32	3 (2-3)	.97
Independent	22	3 (2-4)	4 (3-4)	3.5 (3-5)	.003	.53	12	4 (4-5)	10	3 (3-3)	.004
Endoscopic experience level											
Novice	29	0 (0-1)	2 (1-3)	2 (2-3)	<.001	.42	10	2.5 (2-3.25)	19	2 (2-3)	.54
Intermediate	25	2 (2-3)	3 (3-4)	3 (3-4)	.002	.61	12	3 (2.25-3.75)	13	3 (3-4)	.35
Experienced	21	3 (2-4)	4 (3-4)	4 (3-5)	.003	.53	11	4 (4-5)	10	3 (3-3)	.006
Expert group: participants	4	5 (3.5-5)	4.5 (3.25-5.75)	5 (3.5-5)	1	1	2	5 (5-5)	2	4 (3-5)	.67
Expert group: invited	6	5 (3.75-5)									

Values are median (interquartile range) unless noted otherwise. Comparisons were performed using the Wilcoxon matched-pairs signed rank test and the 2-sample Wilcoxon rank sum (Mann-Whitney) test.

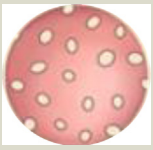
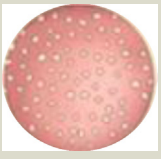
APPENDIX 1. COLONIC LESIONS CLASSIFICATIONS

Modified Paris classification

	Endoscopic appearance		Diagram	Description
Paris classification	Polypoid	Ip		Pedunculated polyps
		Isp		Sub-pedunculated polyps
		Is		Sessile polyps
	Nonpolypoid	IIa		Superficial elevated
		IIb		Flat
		IIc		Slightly depressed
Ulceration	Present			
	Absent			
Borders	Distinct			
	Indistinct			

The SCENIC International Consensus proposed a system to characterize IBD polyps. It considers the modified Paris classification (polypoid and nonpolypoid lesions), the presence of ulcerations, and the borders of lesions (distinct or indistinct).[5] Images created with Biorender.com; Toronto, Ontario, Canada.

Modified Kudo classification

Type	Diagram	Description	Histology
I		Round	Normal
II		Stellar	HP
II-O		Open	SSL
IIIs		Round (smaller than usual pits)	LGD
IIIL		Tubular (larger than usual pits)	
IV		Branch/gyrus	
V		Irregular	HGD/cancer

The Kudo classification characterizes lesions and predicts histology according to a pit pattern.
HGD, High-grade dysplasia; *HP*, hyperplastic; *LGD*, low-grade dysplasia; *SSL*, sessile serrated lesion.[13,14]

Frankfurt Advanced Chromoendoscopic IBD Lesions (FACILE) classification				
Endoscopy findings	**SSLs**	**Inflammatory/pseudopolyps**	**Dysplasia LGD/HGD**	**Cancer**
Morphology • Polypoid • Nonpolypoid	Is	Ip	IIa	IIa + IIc
Surface architecture • Roundish • Villous regular • Villous irregular • Irregular/nonstructural	Roundish	Roundish	Villous irregular	Irregular/nonstructural
Vessel architecture	Nonvisible	Regular	Irregular	Irregular/nonstructural
Inflammation within the lesion Yes/no	No	Yes	Yes	Yes

The FACILE (Frankfurt Advanced Chromoendoscopic IBD Lesions) classification was developed and validated to assess IBD lesions using VCE. It evaluates 4 characteristics (morphology, surface architecture, vessel architecture, and inflammation within the lesion) that can be applied together to predict histology.
HGD, High-grade dysplasia; *LGD*, low-grade dysplasia; *SSL*, sessile serrated lesion.[16]