INTELIGENCIA ARTIFICIAL EN COLONOSCOPIA

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MD, MSc, PhD, FASGE, FSIED

SOCIEDAD INTERAMERICANA DE ENDOSCOPIA DIGESTIVA — SIED

Uniendo la Endoscopía de las Américas

SOU — SANTA CASA DE CARIDADE DE BAGÉ

45° CURSO DE AVANCES EN GASTROENTEROLOGÍA

"BUENAS PRÁCTICAS EN GASTROENTEROLOGÍA"

23-25 de Julio 2025

HOTEL INTERCONTINENTAL SANTIAGO

AV. VITACURA 2885, LAS CONDES

Speaker y consultor de la Fujifilm Co

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2017

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2018 - 2019


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HHS Public Access
Author manuscript
Nature. Author manuscript; available in PMC 2021 August 23.

Published in final edited form as:
Nature. 2017 February 02; 542(7639): 115–118. doi:10.1038/nature21056.

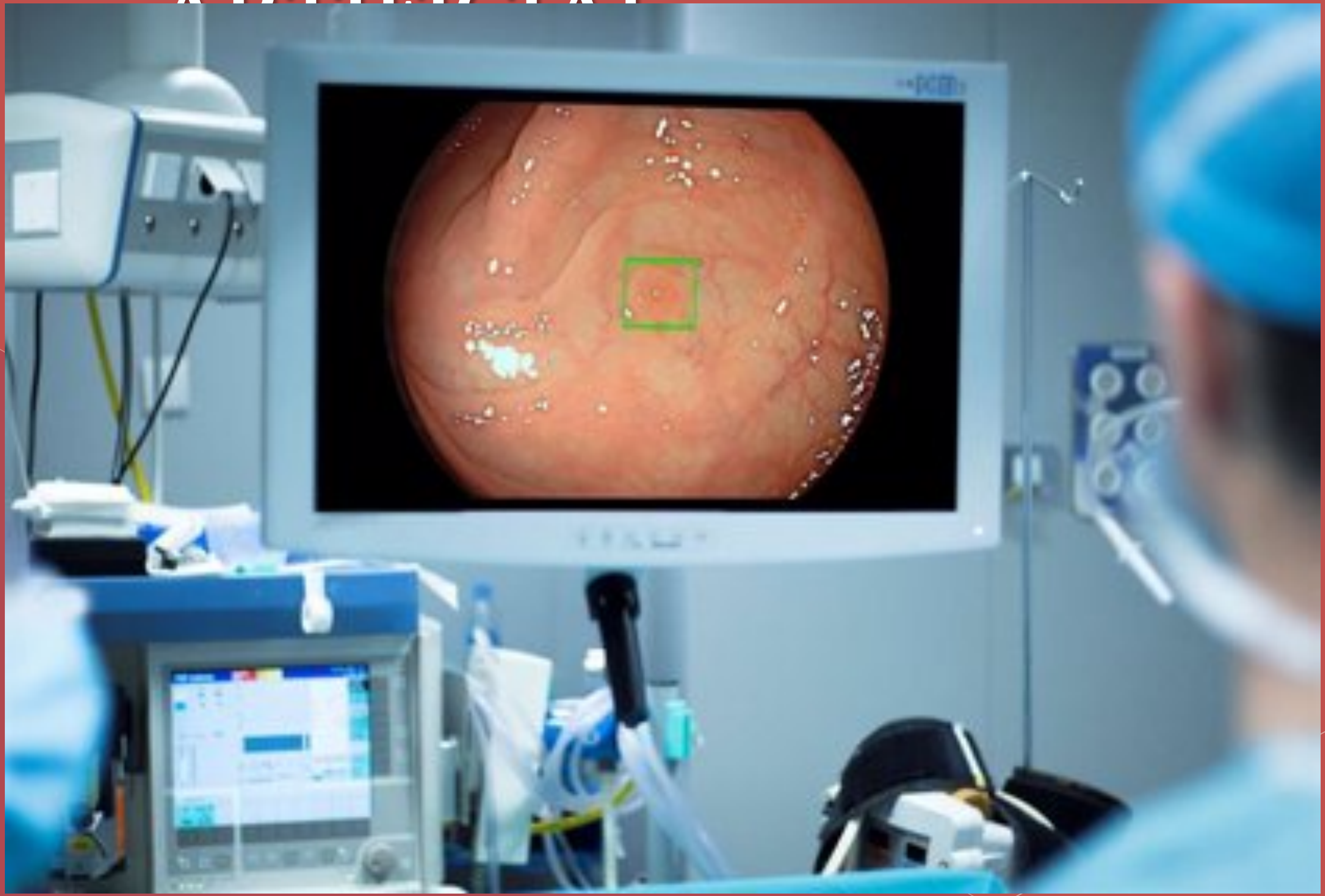
Dermatologist–level classification of skin cancer with deep neural networks

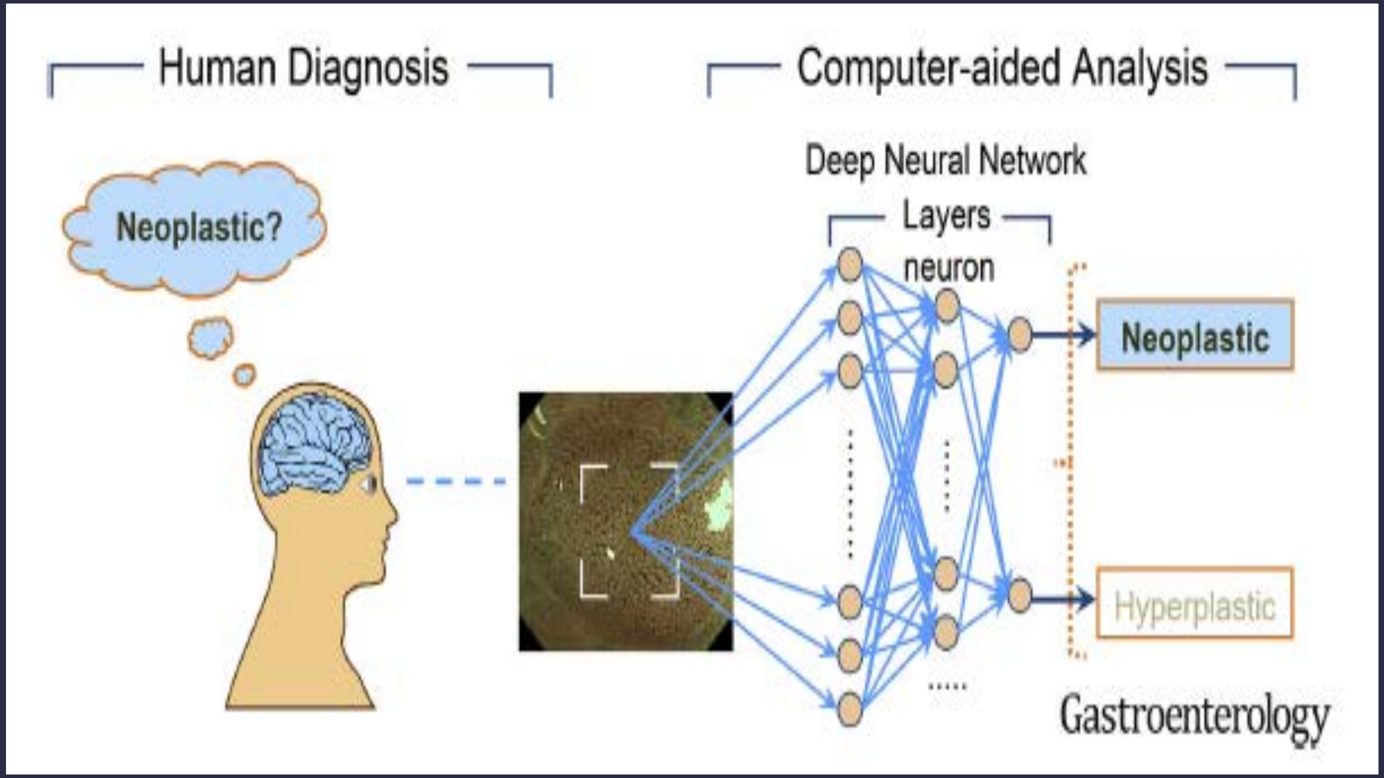
Andre Esteva#[1], Brett Kuprel#[1], Roberto A. Novoa[2,3], Justin Ko[2], Susan M. Swetter[2,4], Helen M. Blau[5], Sebastian Thrun[6]

Abstract

Skin cancer, the most common human malignancy[1–3], is primarily diagnosed visually, beginning with an initial clinical screening and followed potentially by dermoscopic analysis, a biopsy and histopathological examination. Automated classification of skin lesions using images is a challenging task owing to the fine-grained variability in the appearance of skin lesions. Deep convolutional neural networks (CNNs)[4,5] show potential for general and highly variable tasks across many fine-grained object categories[6–11]. Here we demonstrate classification of skin lesions using a single CNN, trained end-to-end from images directly, using only pixels and disease labels as inputs. We train a CNN using a dataset of 129,450 clinical images—two orders of magnitude larger than previous datasets[12]—consisting of 2,032 different diseases. We test its performance against 21 board-certified dermatologists on biopsy-proven clinical images with two critical binary classification use cases: keratinocyte carcinomas versus benign seborrheic keratoses; and malignant melanomas versus benign nevi. The first case represents the identification of the most common cancers, the second represents the identification of the deadliest skin cancer. The CNN achieves performance on par with all tested experts across both tasks, demonstrating an artificial intelligence capable of classifying skin cancer with a level of competence comparable to dermatologists. Outfitted with deep neural networks, mobile devices can potentially extend

INTELIGENCIA ARTIFICIAL





Human Diagnosis
Computer-aided Analysis
Neoplastic?
Deep Neural Network
Layers
neuron
Neoplastic
Hyperplastic
Gastroenterology

Practice Guideline > Gastroenterology. 2025 Apr;168(4):691-700.
doi: 10.1053/j.gastro.2025.01.002.

AGA Living Clinical Practice Guideline on Computer-Aided Detection-Assisted Colonoscopy

Shahnaz Sultan [1], Dennis L Shung [2], Jennifer M Kolb [3], Farid Foroutan [4], Cesare Hassan [5], Charles J Kahi [6], Peter S Liang [7], Theodore R Levin [8], Shazia Mehmood Siddique [9], Benjamin Lebwohl [10]

Results: The panel reached the conclusion that no recommendation could be made for or against the use of CADe-assisted colonoscopy in light of very low certainty of evidence for the critical outcomes, desirable and undesirable (11 fewer colorectal cancers per 10,000 individuals and 2 fewer colorectal cancer deaths per 10,000 individuals), increased burden of more intensive surveillance colonoscopies (635 more per 10,000 individuals), and cost and resource implications. The panel acknowledged the 8% (95% CI, 6%-10%) increase in adenoma detection rate and 2% (95% CI, 0%-4%) increase in advanced adenoma and/or sessile serrated lesion detection rate.

Position Statement

Thieme

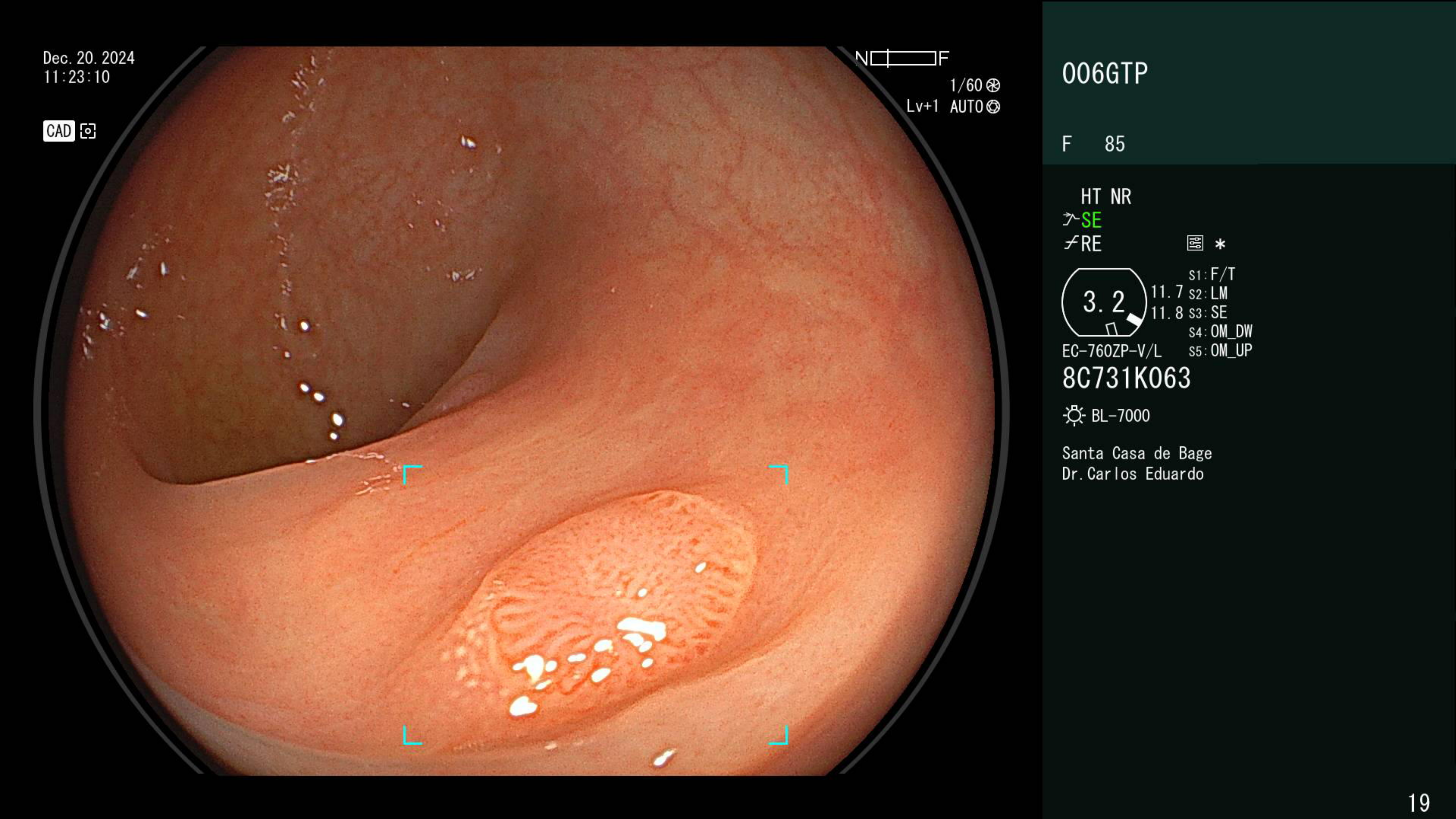
Expected value of artificial intelligence in gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement

ESGE

Messmann et al. Endoscopy 2022

RECOMMENDATIONS:

- (7) For acceptance of AI in the detection of colorectal polyps, the AI-assisted adenoma detection rate should be **comparable to that of experienced endoscopists**.
- (8) For acceptance of AI optical diagnosis (computer-aided diagnosis [CADx]) of diminutive polyps (≤5 mm), AI-assisted characterization should match performance standards for implementing resect-and-discard and diagnose-and-leave strategies.
- (9) For acceptance of AI in the management of polyps ≥ 6 mm, AI-assisted characterization should be **comparable to that of experienced endoscopists** in selecting lesions amenable to endoscopic resection.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Dr. Carlos Eduardo
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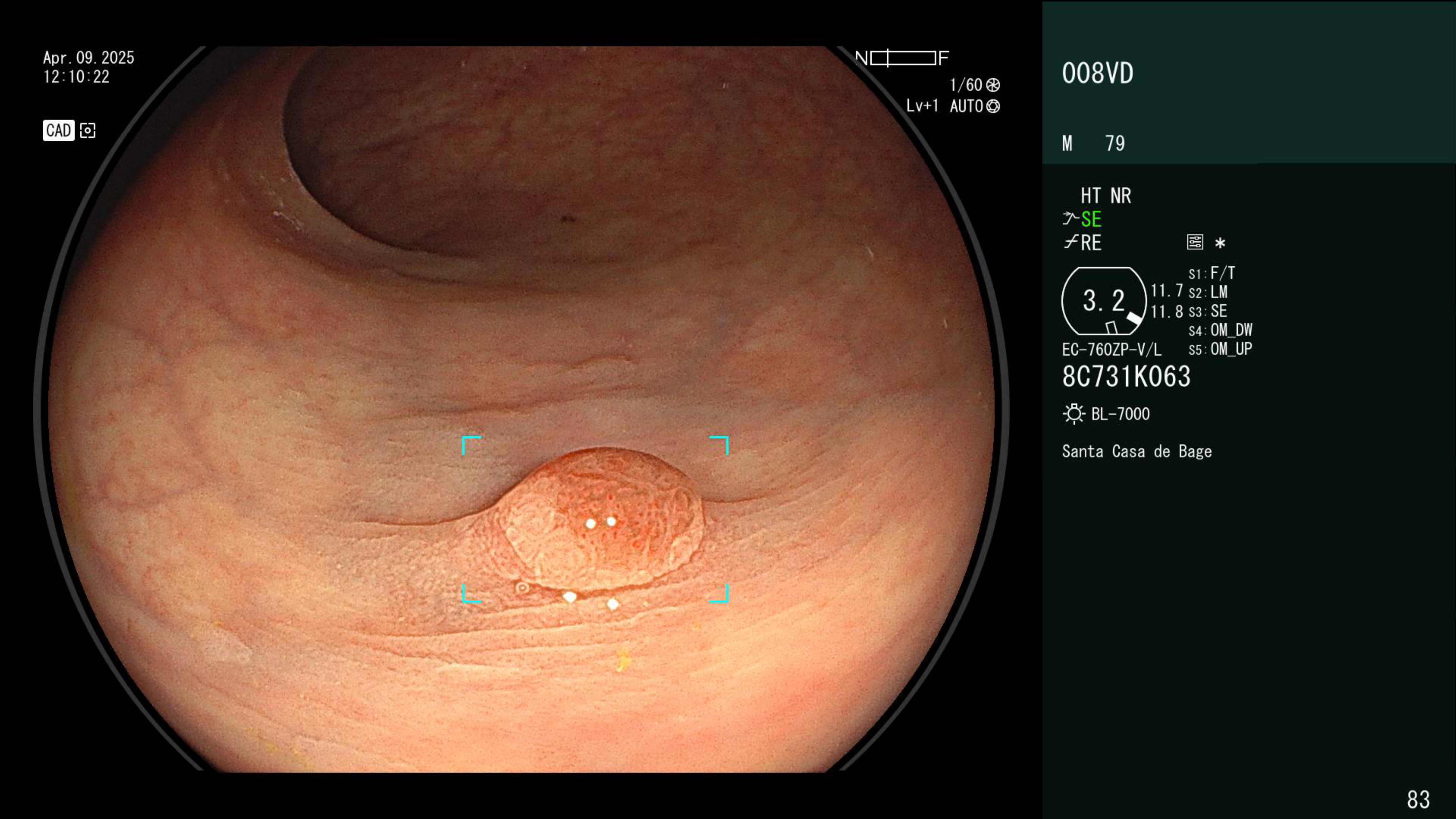
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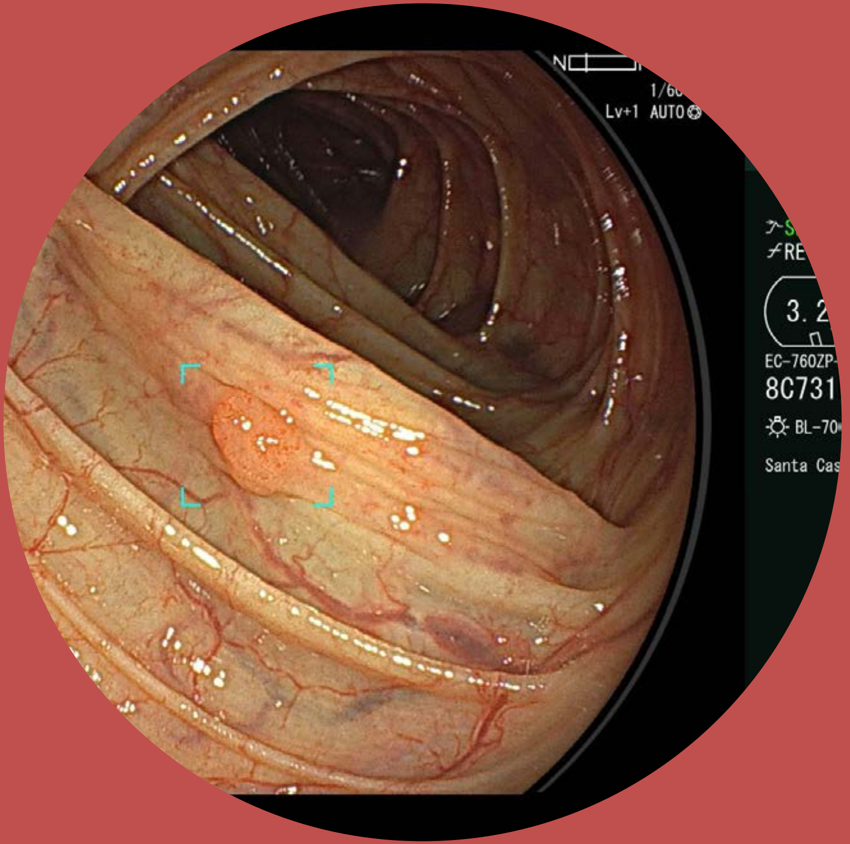
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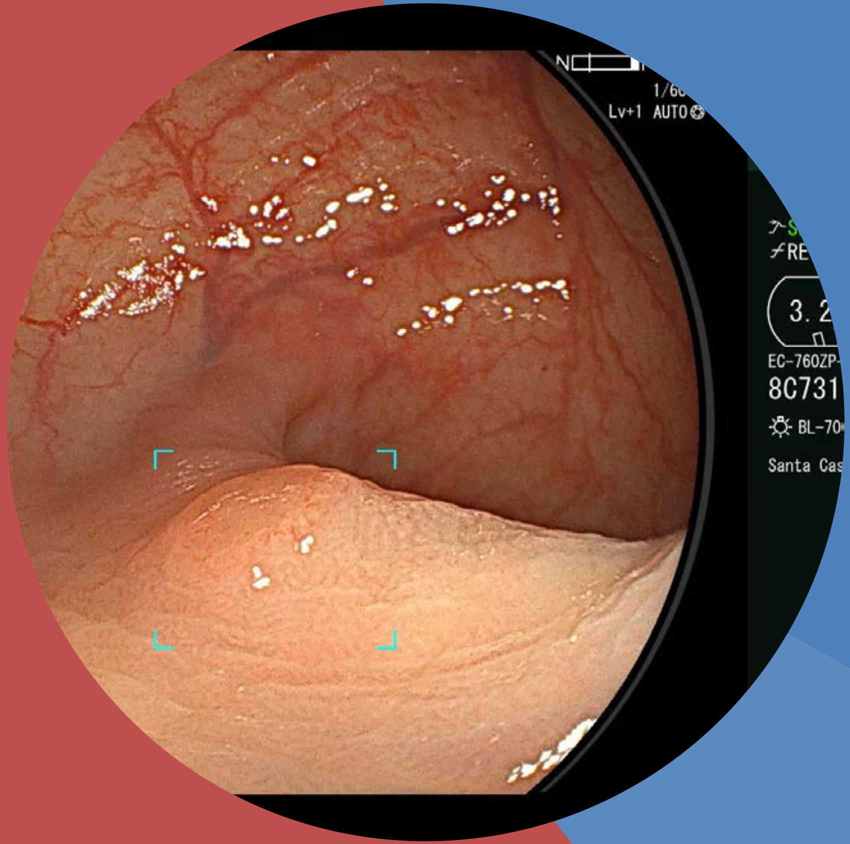
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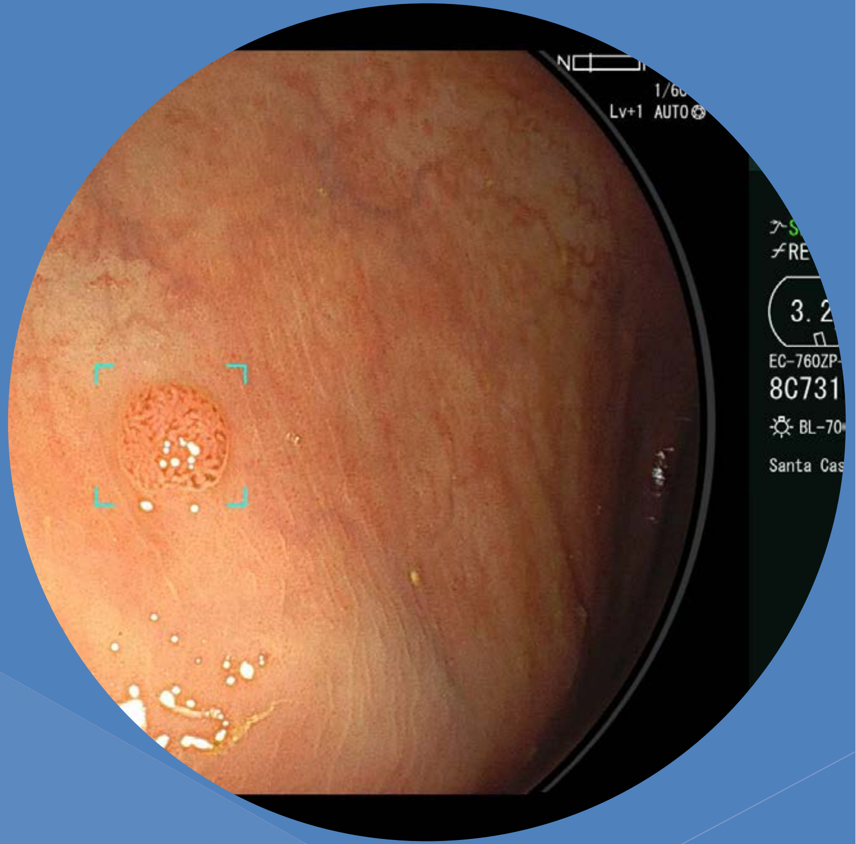
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Gastroenterology 2022;163:295–304

ARTIFICIAL INTELLIGENCE

Impact of Artificial Intelligence on Miss Rate of Colorectal Neoplasia

Michael B. Wallace,[1,2] Prateek Sharma,[3] Pradeep Bhandari,[4] James East,[5] Giulio Antonelli,[6,7,8] Roberto Lorenzetti,[6] Micheal Vieth,[9] Ilaria Speranza,[10] Marco Spadaccini,[6] Madhav Desai,[4] Frank J. Lukens,[1] Genci Babameto,[11] Daisy Batista,[11] Davinder Singh,[11] William Palmer,[1] Francisco Ramirez,[12] Rebecca Palmer,[5] Tisha Lunsford,[12] Kevin Ruff,[12] Elizabeth Bird-Liebermann,[5] Victor Ciofoaia,[11] Sophie Arndtz,[4] David Cangemi,[1] Kirsty Puddick,[4] Gregory Derfus,[13] Amitpal S. Johal,[14] Mohammed Barawi,[15] Luigi Longo,[16] Luigi Moro,[16] Alessandro Repici,[17,18] and Cesare Hassan[17,18]

Table 2. AMR Overall and by Subgroup: FAS Population

	AI first (n = 116)	Standard colonoscopy first (n = 114)	*P* value[a]	OR [95% CI]
Overall				
n/N' (%)	38/246 (15.45)	80/247 (32.39)	<.001	0.38 [0.25–0.59]
Size, *mm*				
≤5	29/183 (15.85)	69/193 (35.75)	<.001	0.34 [0.21–0.55]
≥6 and <10	6/29 (20.69)	8/35 (22.86)	.835	0.88 [0.27–2.91]
<10	35/212 (16.51)	77/228 (33.77)	<.001	0.39 [0.25–0.61]
≥10	2/33 (6.06)	3/19 (15.79)	.342b	0.34 [0.03–3.40]
Morphology				
Polypoid	16/119 (13.45)	25/127 (19.69)	.189	0.63 [0.32–1.26]
Nonpolypoid	21/125 (16.80)	55/120 (45.83)	<.001	0.24 [0.13–0.43]
Location				
Proximal colon	28/153 (18.30)	54/166 (32.53)	.004	0.46 [0.28–0.78]
Distal colon	10/93 (10.75)	26/81 (32.10)	<.001	0.25 [0.11–0.57]
Histology				
Conventional adenomas	34/217 (15.67)	69/214 (32.24)	<.001	0.39 [0.25–0.62]
Carcinomas	0/4 (0.00)	0/1 (0.00)	NC	NC
Sessile serrated lesion	0/5 (0.00)	2/6 (33.33)	.455	0.00 [0.00–4.05]
Hyperplastic polyps of the proximal Colon	4/20 (20.00)	9/26 (34.62)	.275	0.47 [0.12–1.84]

International Journal of Colorectal Disease
https://doi.org/10.1007/s00384-021-03929-3

REVIEW

Artificial intelligence (AI) real-time detection vs. routine colonoscopy for colorectal neoplasia: a meta-analysis and trial sequential analysis

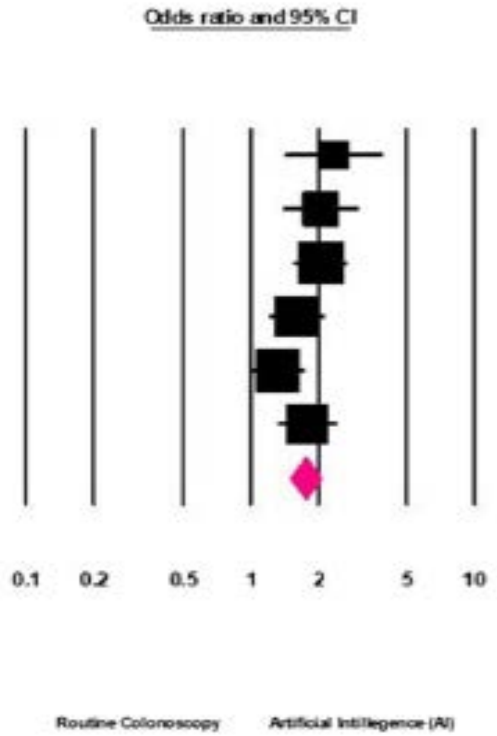
Smit S. Deliwala[1] · Kewan Hamid[2] · Mahmoud Barbarawi[1] · Harini Lakshman[1] · Yazan Zayed[1] · Pujan Kandel[1] · Srikanth Malladi[2] · Adiraj Singh[2] · Ghassan Bachuwa[1] · Grigoriy E. Gurvits[3] · Saurabh Chawla[4]

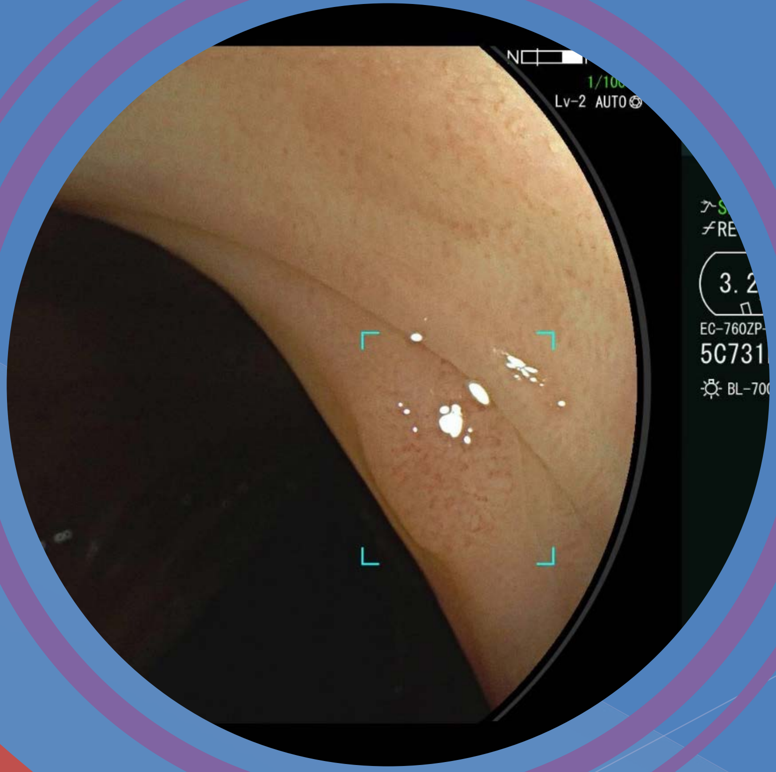
Adenoma Detection Rate (ADR)

Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
Gong D 2020	2.355	1.431	3.876	3.371	0.001
Su et al. 2020	2.057	1.398	3.027	3.660	0.000
Liu 2019	2.053	1.568	2.687	5.235	0.000
Wang P 2019	1.609	1.213	2.135	3.298	0.001
Wang P 2020	1.325	1.007	1.743	2.009	0.045
Repici 2020	1.789	1.321	2.422	3.760	0.000
Total (95% CI)	1.769	1.504	2.080	6.899	0.000

Heterogeneity: $Tau^2 = 0.01$; $I^2 = 35.13\%$; df = 5 (P = 0.17)

Test for overall effect: Z = 6.90 (P = 0.00)





REVIEW

Editorial Process: Submission:06/25/2023 Acceptance:11/10/2023

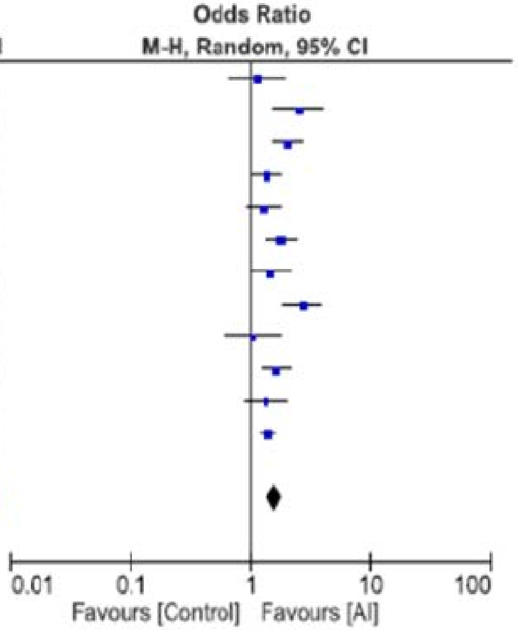
The Impact of Artificial Intelligence in Improving Polyp and Adenoma Detection Rate During Colonoscopy: Systematic-Review and Meta-Analysis

Randy Adiwinata[1]*, Kevin Tandarto[2], Jonathan Arifputra[1], Bradley Jimmy Waleleng[3], Fandy Gosal[3], Luciana Rotty[3], Jeanne Winarta[3], Andrew Waleleng[3], Paulus Simadibrata[4], Marcellus Simadibrata[5]

Study or Subgroup	AI Events	AI Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
Brown et al. (2022)	63	113	58	110	5.1%	1.13 [0.67, 1.91]
Gong et al. (2020)	58	335	27	349	5.7%	2.50 [1.54, 4.05]
Liu et al. (2019)	198	508	124	518	10.3%	2.03 [1.55, 2.66]
P Wang et al. (2020)	165	484	132	478	10.1%	1.36 [1.03, 1.78]
Quan et al. (2022)	131	300	113	300	8.8%	1.28 [0.93, 1.78]
Repici et al. (2020)	187	341	139	344	9.4%	1.79 [1.32, 2.42]
Schaeur et al. (2022)	102	213	82	213	7.5%	1.47 [1.00, 2.16]
Su et al. (2019)	113	308	56	315	7.8%	2.68 [1.85, 3.88]
Wallace et al. (2022)	72	116	70	114	5.0%	1.03 [0.60, 1.75]
Wang et al. (2019)	151	522	107	536	9.9%	1.63 [1.23, 2.17]
Wang et al. (2020)	78	184	66	185	6.8%	1.33 [0.87, 2.02]
Xu et al. (2022)	606	1519	499	1540	13.7%	1.38 [1.19, 1.61]
Total (95% CI)		**4943**		**5002**	**100.0%**	**1.58 [1.37, 1.82]**
Total events	1924		1473			

Heterogeneity: Tau² = 0.03; Chi² = 25.67, df = 11 (P = 0.007); I² = 57%

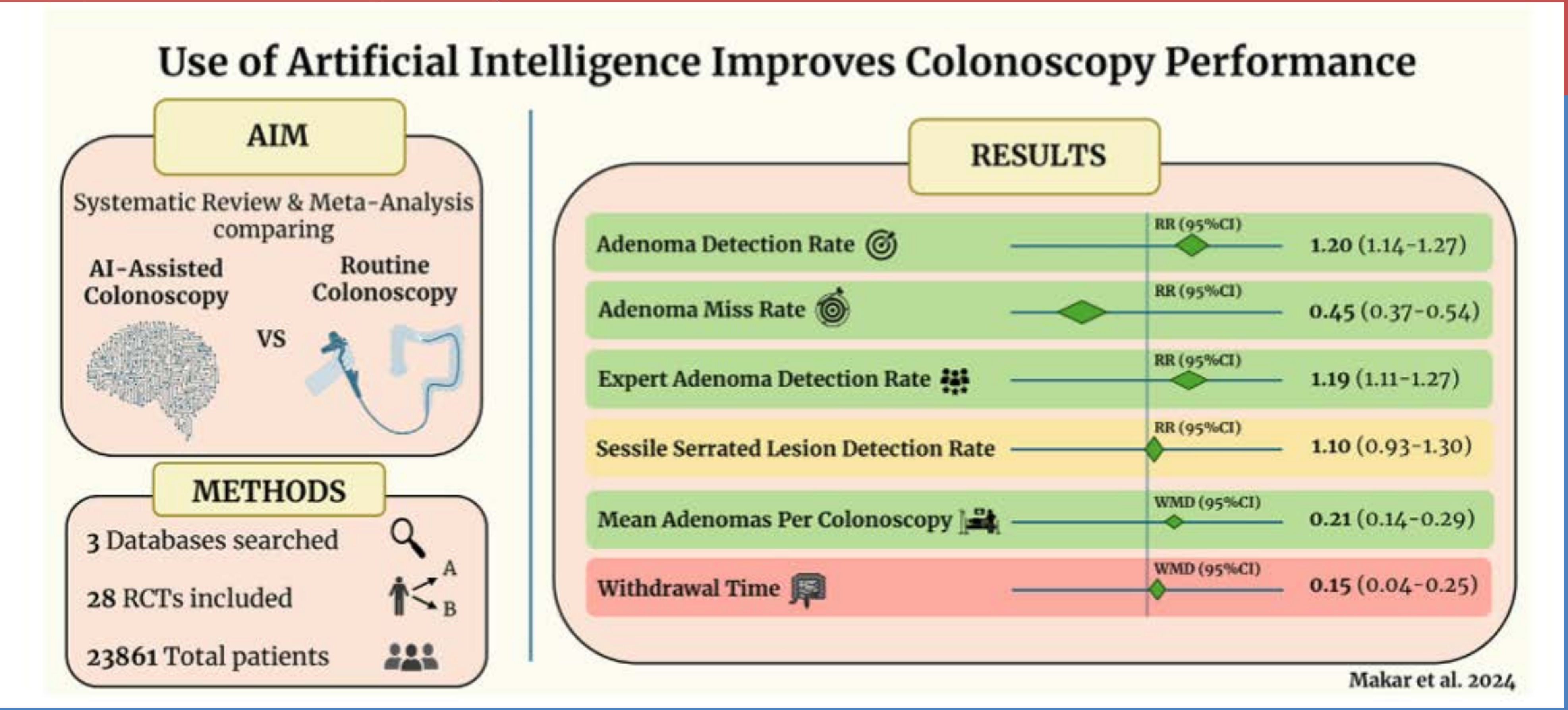
Test for overall effect: Z = 6.24 (P < 0.00001)



SYSTEMATIC REVIEW AND META-ANALYSIS

Use of artificial intelligence improves colonoscopy performance in adenoma detection: a systematic review and meta-analysis

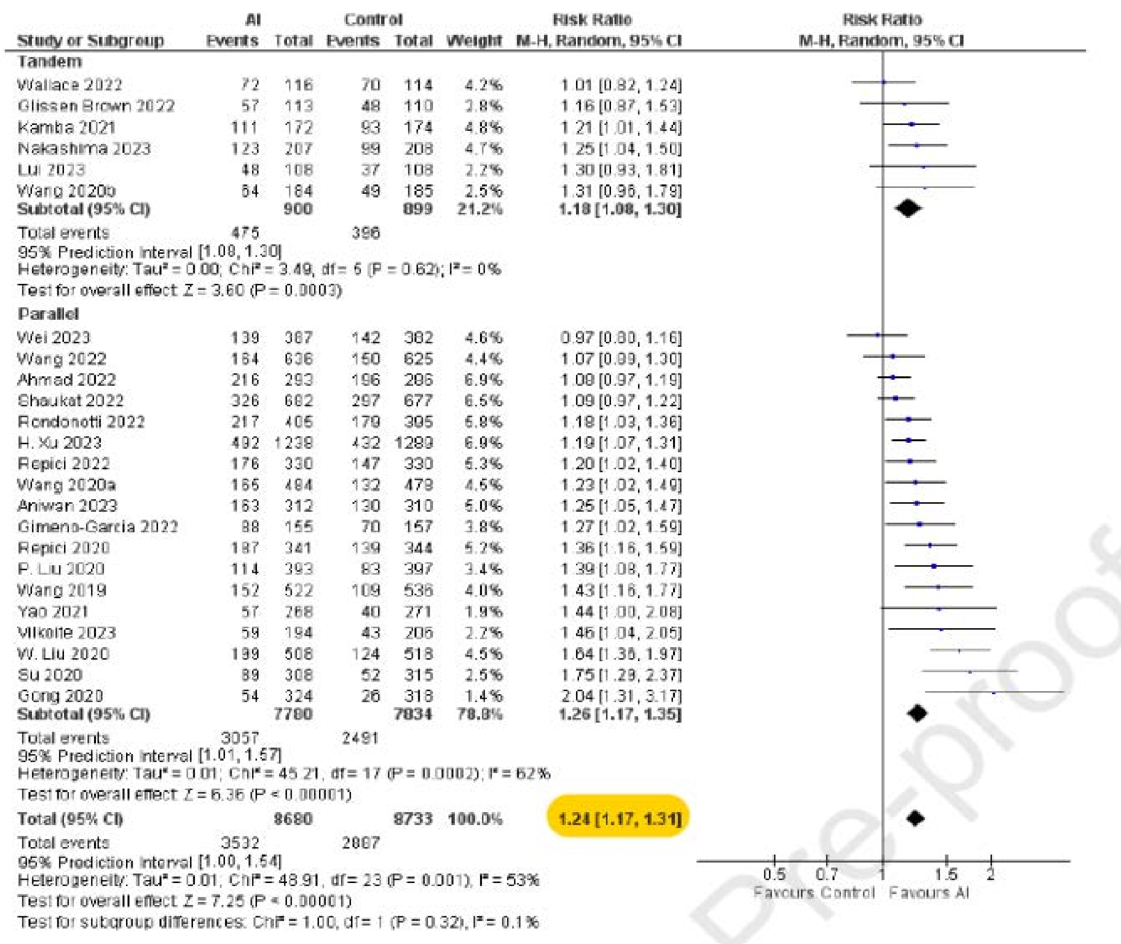
Jonathan Makar, BSc,[1] Jonathan Abdelmalak, MBBS (Hons), FRACP,[2,3,4] Danny Con, MD, FRACP,[1,2]
Bilal Hafeez, BSc,[1] Mayur Garg, MBBS, PhD, FRACP[1,5]



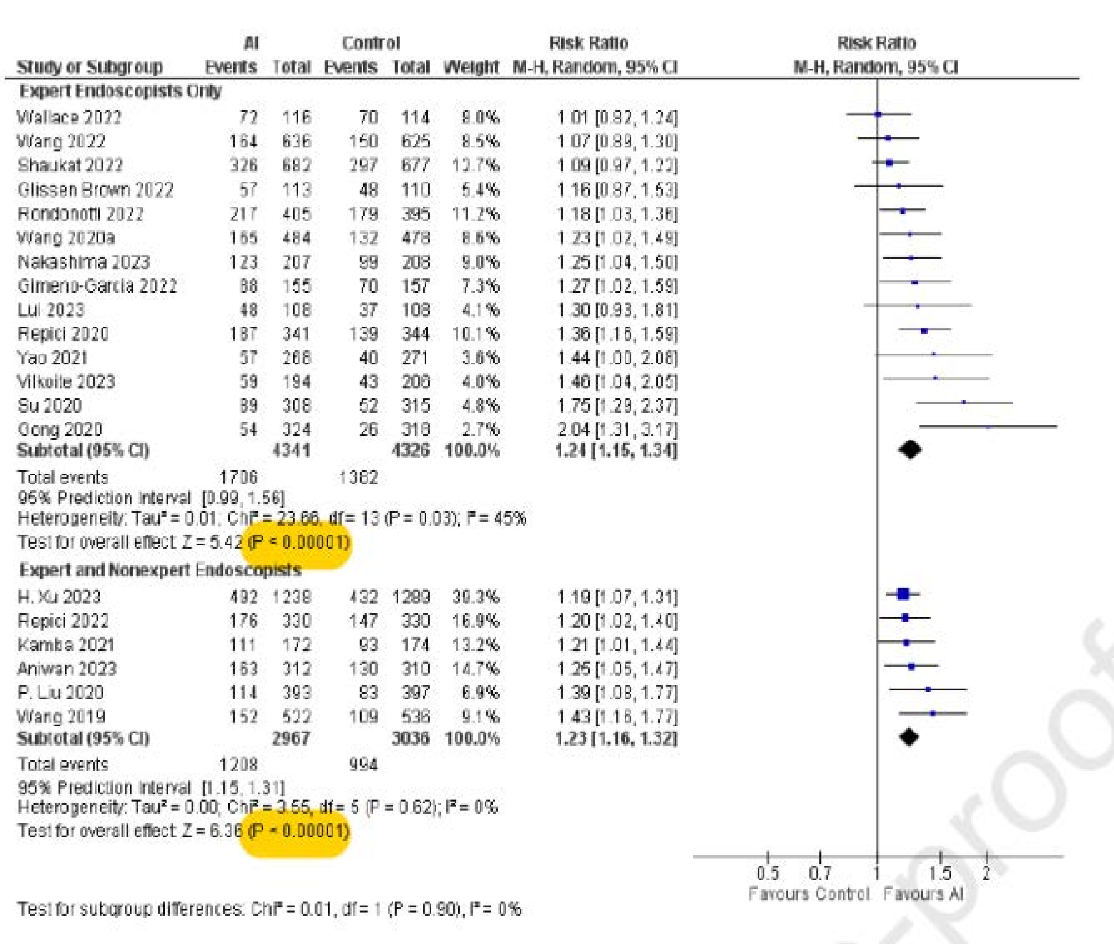
Review > Gastrointest Endosc. 2024 May;99(5):676-687.e16. doi: 10.1016/j.gie.2024.01.021. Epub 2024 Jan 24.

Impact of study design on adenoma detection in the evaluation of artificial intelligence–aided colonoscopy: a systematic review and meta-analysis

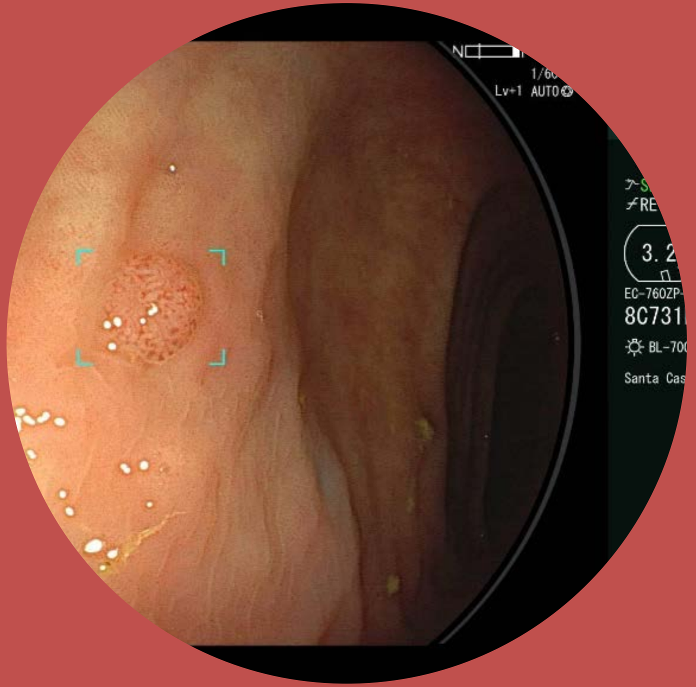
Michelle C M Lee [1], Colleen H Parker [1], Louis W C Liu [1], Armin Farahvash [2], Thurarshen Jeyalingam [1]



Study or Subgroup	AI Events	AI Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
Tandem						
Wallace 2022	72	116	70	114	4.2%	1.01 [0.82, 1.24]
Glissen Brown 2022	57	113	48	110	3.8%	1.16 [0.87, 1.53]
Kamba 2021	111	172	93	174	4.8%	1.21 [1.01, 1.44]
Nakashima 2023	123	207	99	208	4.7%	1.25 [1.04, 1.50]
Lui 2023	48	108	37	108	2.2%	1.30 [0.93, 1.81]
Wang 2020b	64	184	49	185	2.5%	1.31 [0.96, 1.79]
Subtotal (95% CI)		**900**		**899**	**21.2%**	**1.18 [1.08, 1.30]**
Total events	475		396			
95% Prediction Interval [1.08, 1.30]						
Heterogeneity: Tau² = 0.00; Chi² = 3.49, df = 5 (P = 0.62); I² = 0%						
Test for overall effect: Z = 3.60 (P = 0.0003)						
Parallel						
Wei 2023	139	367	142	382	4.6%	0.97 [0.80, 1.16]
Wang 2022	164	636	150	625	4.4%	1.07 [0.89, 1.30]
Ahmad 2022	216	293	196	286	6.9%	1.08 [0.97, 1.19]
Shaukat 2022	326	682	297	677	6.5%	1.09 [0.97, 1.22]
Rondonotti 2022	217	405	179	395	5.8%	1.18 [1.03, 1.36]
H. Xu 2023	492	1238	432	1289	6.9%	1.19 [1.07, 1.31]
Repici 2022	176	330	147	330	5.3%	1.20 [1.02, 1.40]
Wang 2020a	165	484	132	478	4.5%	1.23 [1.02, 1.49]
Aniwan 2023	163	312	130	310	5.0%	1.25 [1.05, 1.47]
Gimeno-Garcia 2022	88	155	70	157	3.8%	1.27 [1.02, 1.59]
Repici 2020	187	341	139	344	5.2%	1.36 [1.16, 1.59]
P. Liu 2020	114	393	83	397	3.4%	1.39 [1.08, 1.77]
Wang 2019	152	522	109	536	4.0%	1.43 [1.16, 1.77]
Yao 2021	57	268	40	271	1.9%	1.44 [1.00, 2.08]
Vilkoite 2023	59	194	43	206	2.2%	1.46 [1.04, 2.05]
W. Liu 2020	199	508	124	518	4.5%	1.64 [1.36, 1.97]
Su 2020	89	308	52	315	2.5%	1.75 [1.29, 2.37]
Gong 2020	54	324	26	318	1.4%	2.04 [1.31, 3.17]
Subtotal (95% CI)		**7780**		**7834**	**78.8%**	**1.26 [1.17, 1.35]**
Total events	3057		2491			
95% Prediction Interval [1.01, 1.57]						
Heterogeneity: Tau² = 0.01; Chi² = 45.21, df = 17 (P = 0.0002); I² = 62%						
Test for overall effect: Z = 6.36 (P < 0.00001)						
Total (95% CI)		**8680**		**8733**	**100.0%**	**1.24 [1.17, 1.31]**
Total events	3532		2887			
95% Prediction Interval [1.00, 1.54]						
Heterogeneity: Tau² = 0.01; Chi² = 48.91, df = 23 (P = 0.001); I² = 53%						
Test for overall effect: Z = 7.25 (P < 0.00001)						
Test for subgroup differences: Chi² = 1.00, df = 1 (P = 0.32), I² = 0.1%						



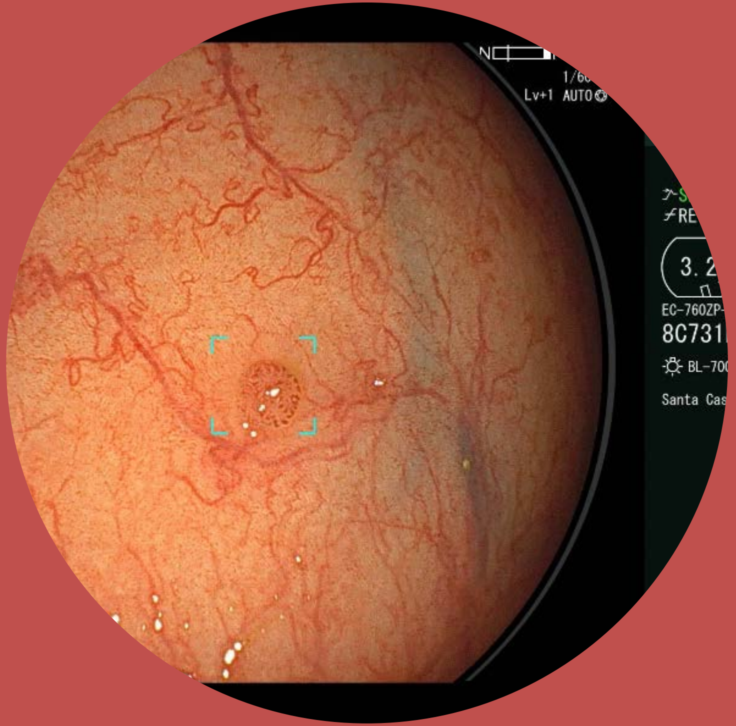
Study or Subgroup	AI Events	AI Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
Expert Endoscopists Only						
Wallace 2022	72	116	70	114	8.0%	1.01 [0.82, 1.24]
Wang 2022	164	636	150	625	8.5%	1.07 [0.89, 1.30]
Shaukat 2022	326	682	297	677	13.7%	1.09 [0.97, 1.22]
Glissen Brown 2022	57	113	48	110	5.4%	1.16 [0.87, 1.53]
Rondonotti 2022	217	405	179	395	11.2%	1.18 [1.03, 1.36]
Wang 2020a	165	484	132	478	8.6%	1.23 [1.02, 1.49]
Nakashima 2023	123	207	99	208	9.0%	1.25 [1.04, 1.50]
Gimeno-Garcia 2022	88	155	70	157	7.3%	1.27 [1.02, 1.59]
Lui 2023	48	108	37	108	4.1%	1.30 [0.93, 1.81]
Repici 2020	187	341	139	344	10.1%	1.36 [1.16, 1.59]
Yao 2021	57	268	40	271	3.6%	1.44 [1.00, 2.08]
Vilkoite 2023	59	194	43	206	4.0%	1.46 [1.04, 2.05]
Su 2020	89	308	52	315	4.8%	1.75 [1.29, 2.37]
Gong 2020	54	324	26	318	2.7%	2.04 [1.31, 3.17]
Subtotal (95% CI)		**4341**		**4326**	**100.0%**	**1.24 [1.15, 1.34]**
Total events	1706		1362			
95% Prediction Interval [0.99, 1.56]						
Heterogeneity: Tau² = 0.01; Chi² = 23.66, df = 13 (P = 0.03); I² = 45%						
Test for overall effect: Z = 5.42 (P < 0.00001)						
Expert and Nonexpert Endoscopists						
H. Xu 2023	492	1238	432	1289	39.3%	1.19 [1.07, 1.31]
Repici 2022	176	330	147	330	16.9%	1.20 [1.02, 1.40]
Kamba 2021	111	172	93	174	13.2%	1.21 [1.01, 1.44]
Aniwan 2023	163	312	130	310	14.7%	1.25 [1.05, 1.47]
P. Liu 2020	114	393	83	397	6.9%	1.39 [1.08, 1.77]
Wang 2019	152	522	109	536	9.1%	1.43 [1.16, 1.77]
Subtotal (95% CI)		**2967**		**3036**	**100.0%**	**1.23 [1.16, 1.32]**
Total events	1208		994			
95% Prediction Interval [1.15, 1.31]						
Heterogeneity: Tau² = 0.00; Chi² = 3.55, df = 5 (P = 0.62); I² = 0%						
Test for overall effect: Z = 6.36 (P < 0.00001)						
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.90), I² = 0%						



White light imaging versus artificial intelligence-assisted white light imaging for colorectal neoplasia detection: a randomised trial

Santos et al 2025 (Submitted)

Variable	All (n=711)	WLI group (n=357)	WLI+AI group (n=354)	p-value*
PDR (%)	65.4	63.0	67.8	0.21
ADR (%)	48.4	45.9	50.8	0.20
SDR (%)	9.0	9.0	9.0	1.00
NDR (%)	53.9	51.0	56.8	0.13
AADR (%)	8.0	8.4	7.6	0.78



White light imaging versus artificial intelligence-assisted white light imaging for colorectal neoplasia detection: a randomised trial

Santos et al 2025 (Submitted)

Indication	All	WLI group	WLI+AI group	p-value*
	N (%)	N (%)	N (%)	
Screening	127 (55.0)	60 (49.2)	67 (61.5)	0.06
Surveillance	148 (49.0)	76 (50.7)	72 (47.4)	0.57
Diagnostic	69 (40.0)	28 (32.9)	41 (44.1)	0.13
p-value	0.01	0.02	0.03	

ORIGINAL ARTICLE

Digestive Diseases and Sciences (2024) 69:1380–1388

Single Versus Second Observer vs Artificial Intelligence to Increase the ADENOMA Detection Rate of Colonoscopy—A Network Analysis

Manesh Kumar Gangwani[1] · Hossein Haghbin[2] · Rizwan Ishtiaq[3] · Fariha Hasan[4] · Julia Dillard[1] · Fouad Jaber[5] · Dushyant Singh Dahiya[6] · Hassam Ali[7] · Shaharyar Salim[8] · Wade Lee-Smith[9] · Amir Humza Sohail[10] · Sumant Inamdar[11] · Muhammad Aziz[12] · Benjamin Hart[13]

Results We analyzed 26 studies, involving 22,560 subjects. In the direct comparative analysis, AI demonstrated higher ADR (OR: 0.668, 95% CI 0.595–0.749, $p<0.001$) than single observer. Dual observer demonstrated a higher ADR (OR: 0.771, 95% CI 0.688–0.865, $p<0.001$) than single operator. In network meta-analysis, results were consistent on the network meta-analysis, maintaining consistency. No statistical difference was noted when comparing AI to second observer. (RR 1.1 (0.9–1.2, $p=0.3$). Results were consistent when evaluating only RCTs. Net ranking provided higher score to AI followed by second observer followed by single observer.

Conclusion Artificial Intelligence and second-observer colonoscopy showed superior success in Adenoma Detection Rate when compared to single-observer colonoscopy. Although not statistically significant, net ranking model favors the superiority of AI to the second observer.

ORIGINAL ARTICLE

Digestive Diseases and Sciences (2024) 69:1380–1388

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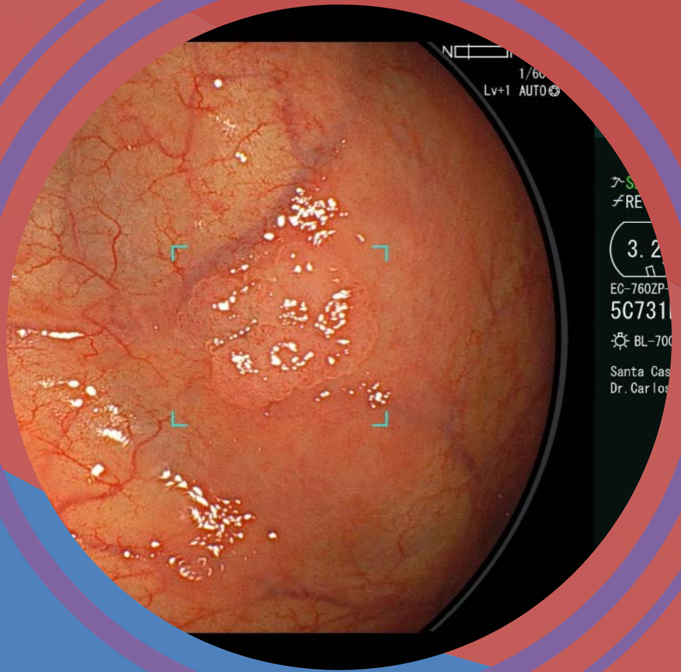


 Thieme

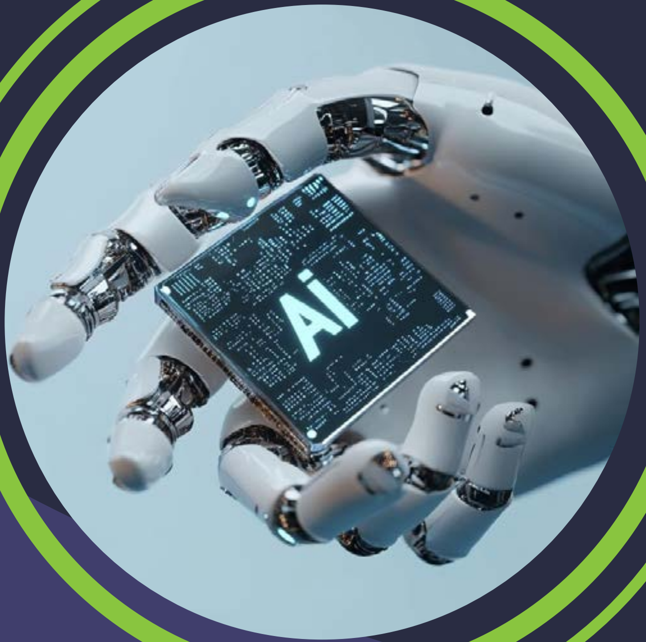
Real-time, computer-aided, detection-assisted colonoscopy eliminates differences in adenoma detection rate between trainee and experienced endoscopists

Authors
Giuseppe Biscaglia*[, 1], Francesco Cocomazzi*[, 1], Marco Gentile[1], Ilaria Loconte[2], Alessia Mileti[2], Rosa Paolillo[2], Antonella Marra[1], Stefano Castellana[3], Tommaso Mazza[3], Alfredo Di Leo[2], Francesco Perri[1]

▶ **Fig. 3** Summary of results.

		Trainees + AI group (45)	Expert endoscopists group (45)	P value
	ADR	38 % (17)	40 % (18)	1
	APC	0.93 (42)	1.07 (48)	1
	PDR	62 % (28)	58 % (26)	0.72
	PPC	1.93 (87)	2.22 (100)	0.69
	AMR	12.5 %		
	PMR	13 %		
		Detections (87)	Detections (100)	
Morphology	NPL	23 % (20)	28 % (28)	0.86
	Polyps	23 % (20)	22% (22)	1
Size	Diminutive	54 % (47)	50 % (50)	0.91
	Lesions > 5 mm	46 % (40)	50% (50)	0.90
Location	Proximal	46 % (40)	45 % (45)	1
	Distal	54 % (47)	55% (55)	1

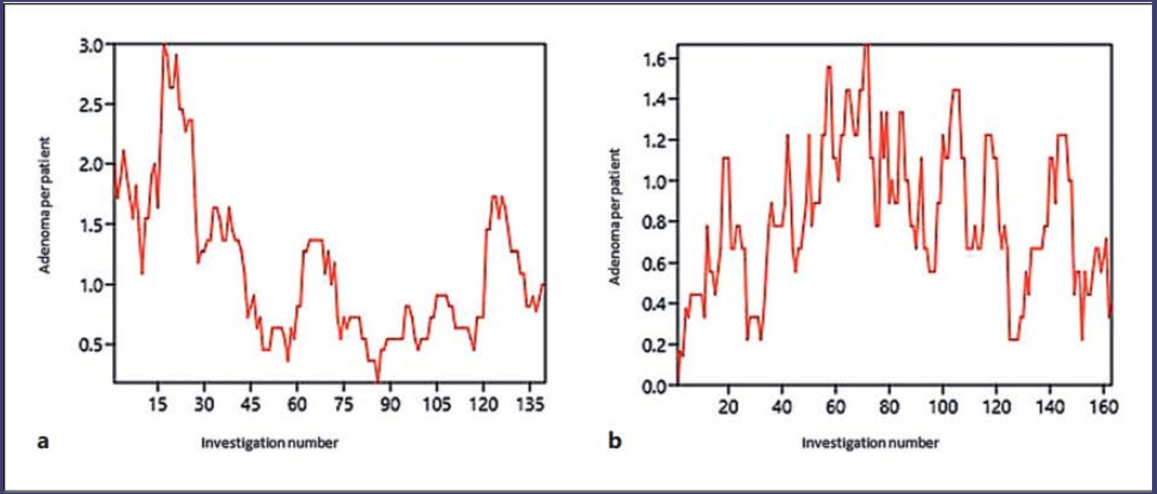
AI, artificial intelligence; ADR, adenoma detection rate; APC, adenoma per colonoscopy; PDR, polyp detection rate; PPC, polyp per colonoscopy; AMR, adenoma miss rate; PMR, polyp miss rate; NPL, non-polypoid lesion.

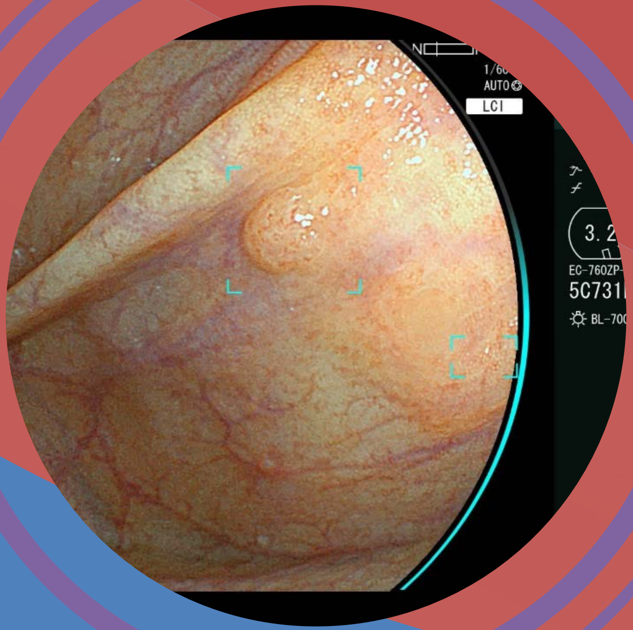


Influence of Artificial Intelligence on the Adenoma Detection Rate throughout the Day

Rino Richter Johannes Bruns Wilfried Obst Verena Keitel-Anselmino Jochen Weigt

polyp detection. ***Results:*** A total of 303 colonoscopies were analyzed. 163 endoscopies in the AI^{+} group and 140 procedures in the AI^{-} group were included. In both groups, the total adenoma detection rate was equal (AI^{+} 0.39 vs. AI^{-} 0.43). The adenoma detection rate throughout the day had a significant decreasing trend in the group without the use of AI ($p = 0.015$), whereas this trend was not present in the investigations that have been performed with AI ($p = 0.65$). The duration of





Original article

Thieme

Linked-color imaging with or without artificial intelligence for adenoma detection: a randomized trial

OPEN ACCESS

Authors
Kazuya Miyaguchi[1], Yoshikazu Tsuzuki[1], Nobutaka Hirooka[2], Hisashi Matsumoto[2], Hideki Ohgo[3], Hidetomo Nakamoto[2], Hiroyuki Imaeda[1]

▶ **Table 3** Adenoma detection with linked-color imaging, with and without assistance from artificial intelligence.

	LCA (n = 400)	LCI (n = 400)	Between-group differences[1] [95%CI]	*P* value[2]
ADR, n (%) [95%CI]	235 (58.8) [53.8 to 63.6]	174 (43.5) [38.6 to 48.5]	15.25 [8.40 to 22.10]	<0.001
▪ ADR in experts	145/258 (56.2) [49.9 to 62.3]	116/251 (46.2) [39.9 to 52.6]	9.99 [1.34 to 18.63]	0.02
▪ ADR in trainees	90/142 (63.4) [54.9 to 71.3]	58/149 (38.9%) [31.1 to 47.2]	24.45 [13.31 to 35.59]	<0.001
Relative risk [95%CI] (vs. LCI)				
▪ ADR	1.351 [1.176 to 1.551]	–	–	
▪ ADR in experts	1.216 [1.024 to 1.444]	–	–	
▪ ADR in trainees	1.628 [1.285 to 2.063]	–	–	

[LCA, linked-color imaging with artificial intelligence-assisted colonoscopy; LC, linked-color imaging-assisted colonoscopy; ADR, adenoma detection rate.
[1]LCA – LCI.
[2]Chi-squared test.

Linked color imaging versus artificial intelligence-assisted linked color imaging for neoplasia detection in the colorectum: a randomized trial

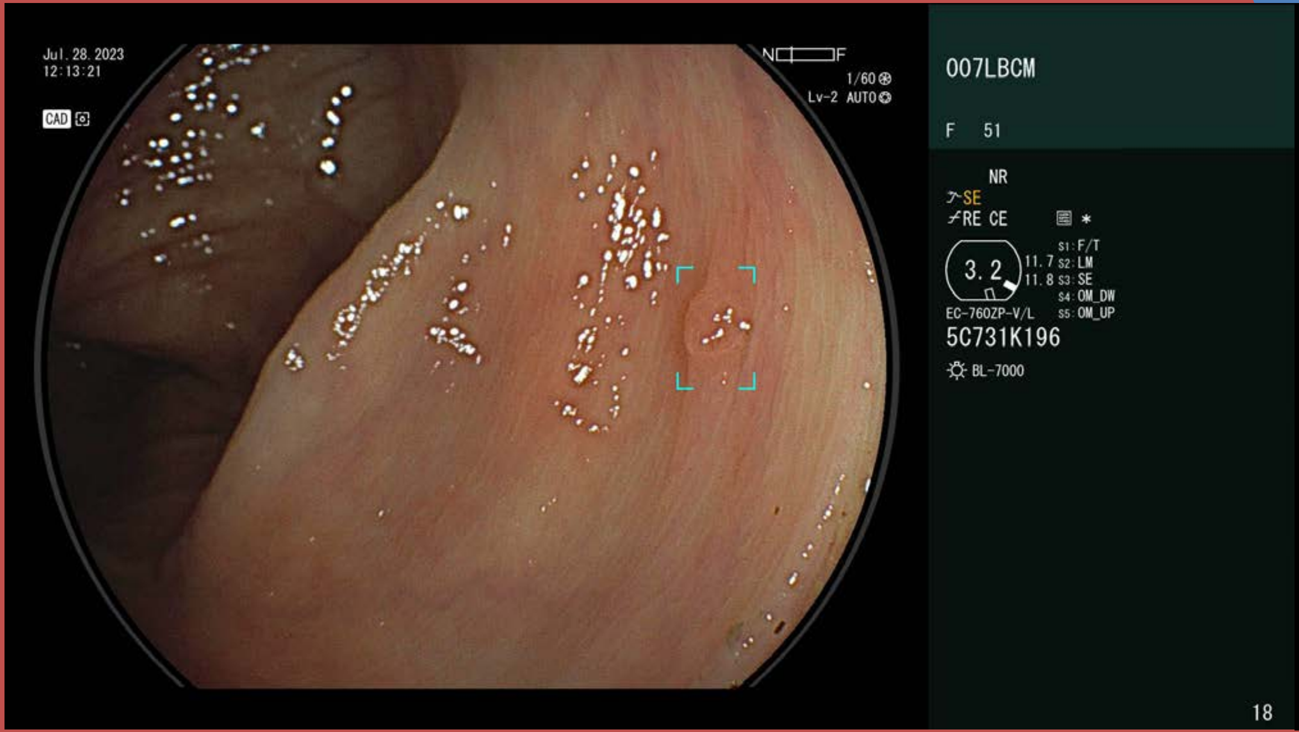
Santos et al. 2025 (Submitted)

Characteristic	All (n=622)	LCI group (n=304)	LCI+AI group (n=318)	p-value*
	Mean	Mean	Mean	
Cecal intubation time (min)	3.8	3.8	3.9	0.71
Withdrawal time (min)	11.8	11.8	11.8	0.93
Polyps/patient (number)	1.3	1.2	1.3	0.14
Adenomas/patient (number)	0.9	0.9	0.9	0.19
PDR (%)	66.9	65.1	68.6	0.42
ADR (%)	50.4	48.0	52.6	0.13
SDR (%)	8.4	8.2	8.5	0.90
NDR (%)	54.5	52.3	56.6	0.30
AADR (%)	5.8	5.9	5.7	1.0

Linked color imaging versus artificial intelligence-assisted linked color imaging for neoplasia detection in the colorectum: a randomized trial

Santos et al. 2025 (Submitted)

Group	LCI	LCI+AI	P-value
Screening	54.6% (45.1-64.2)	63.4% (54.8-72.1)	0.33
Surveillance	47.0% (37.8-56.2)	51.1% (42.5-59.7)	0.69
Simptoms	35.4% (24.7-46.2)	37.1% (24.7-49.5)	0.83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SE
RE CE
3. 2
11. 7
11. 8
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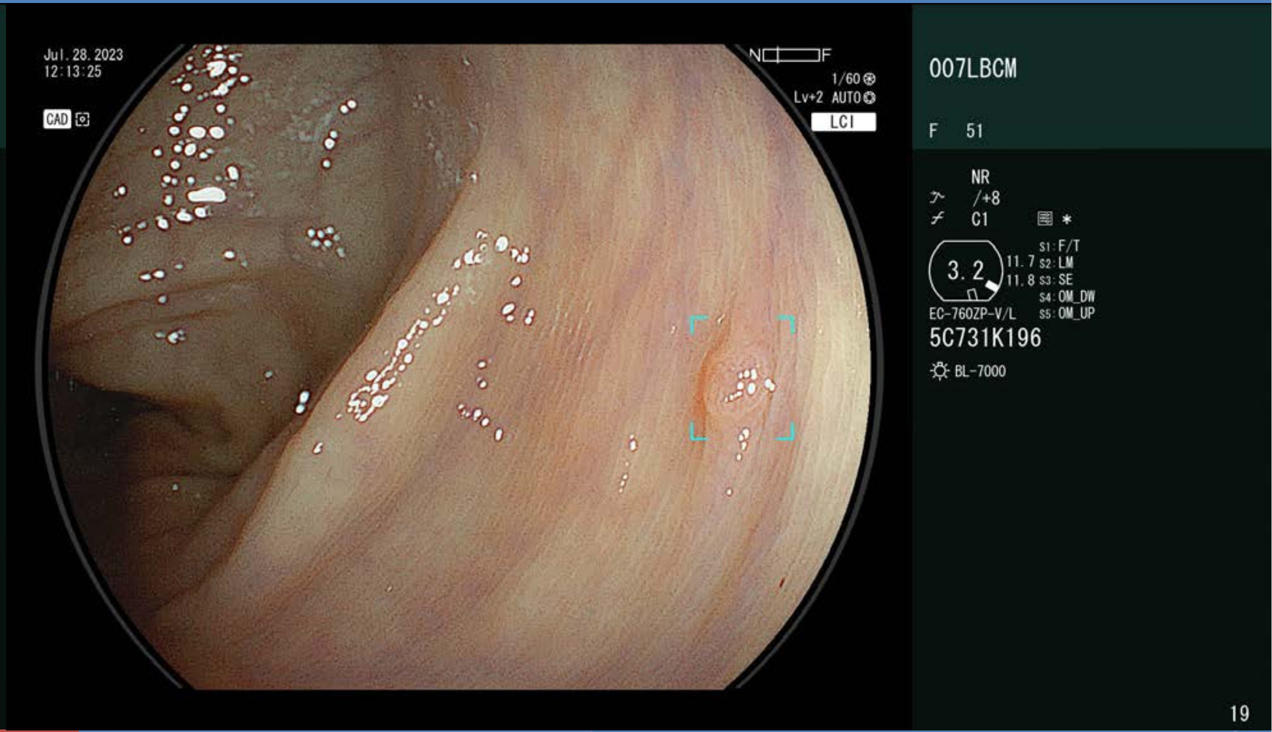
S3: SE
S4: OM_DW
S5: OM_UP
EC-760ZP-V/L
5C731K196
BL-7000
18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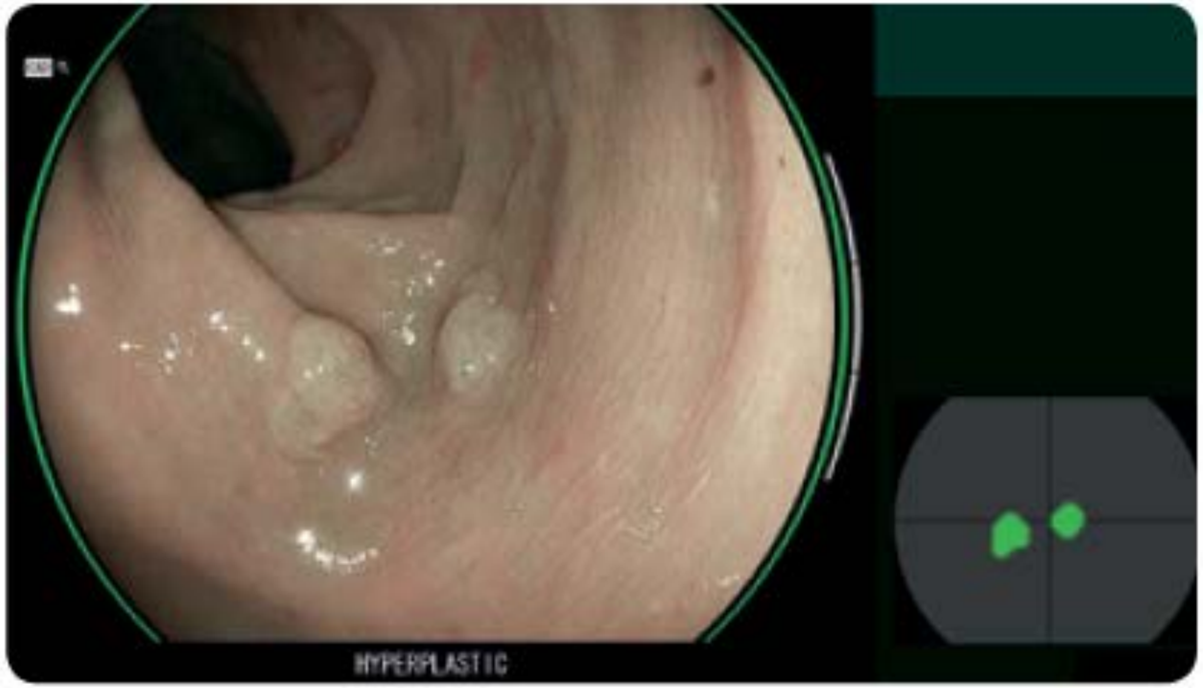
S1: F/T
S2: LM
S3: SE
S4: OM_DW
S5: OM_UP
EC-760ZP-V/L
5C731K196
BL-7000
19

CHARACTERISATION SUPPORT

Once a suspected polyp is detected by CAD EYE Detection (WLI or LCI), CAD EYE Characterisation – in combination with BLI – can support endoscopists in the diagnosis of the polyp. This function analyses in real-time and without freezing or zooming if a polyp is hyperplastic or neoplastic, which is visually indicated by the use of different colour codes in the Position Map. CAD EYE Characterisation is aimed to make procedures more efficient by increasing the accuracy of diagnosis to expert-level.*

BLI Mode – Neoplastic



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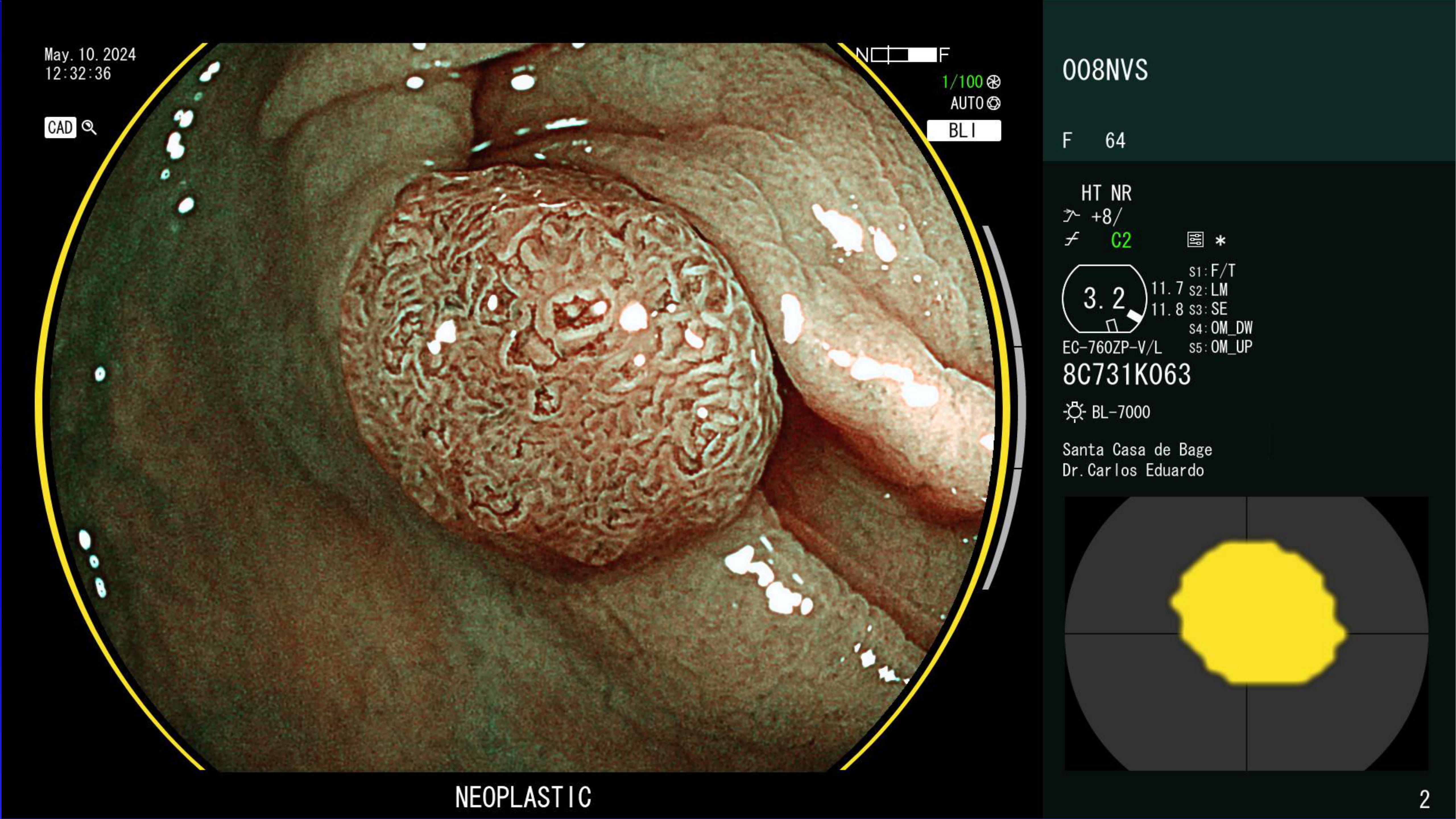
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11. 8
S1: F/T
S2: LM
S3: SE
S4: OM_DW
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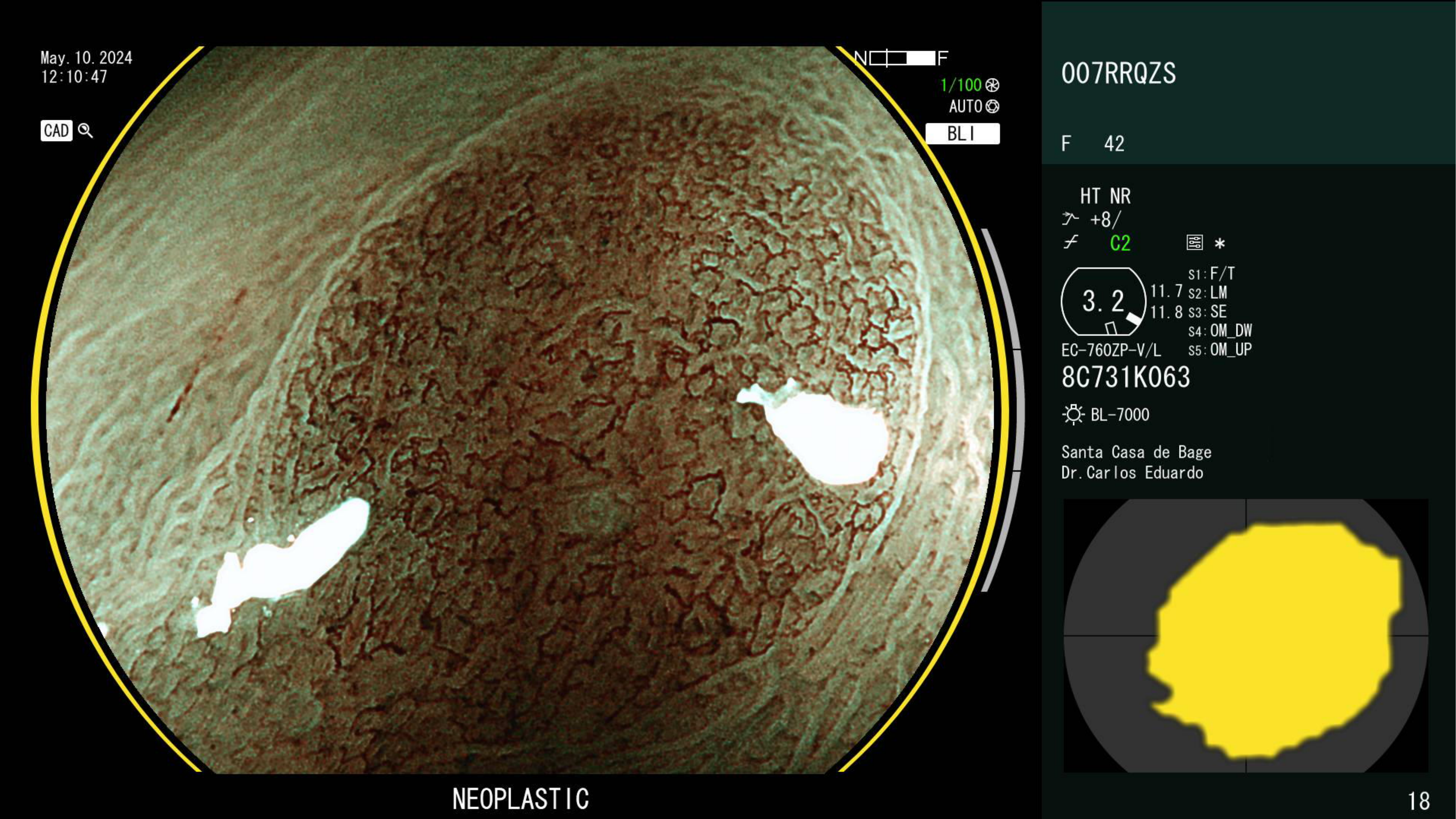
Santa Casa de Bage
Dr. Carlos Eduardo
2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S1: F/T
S2: LM
S3: SE
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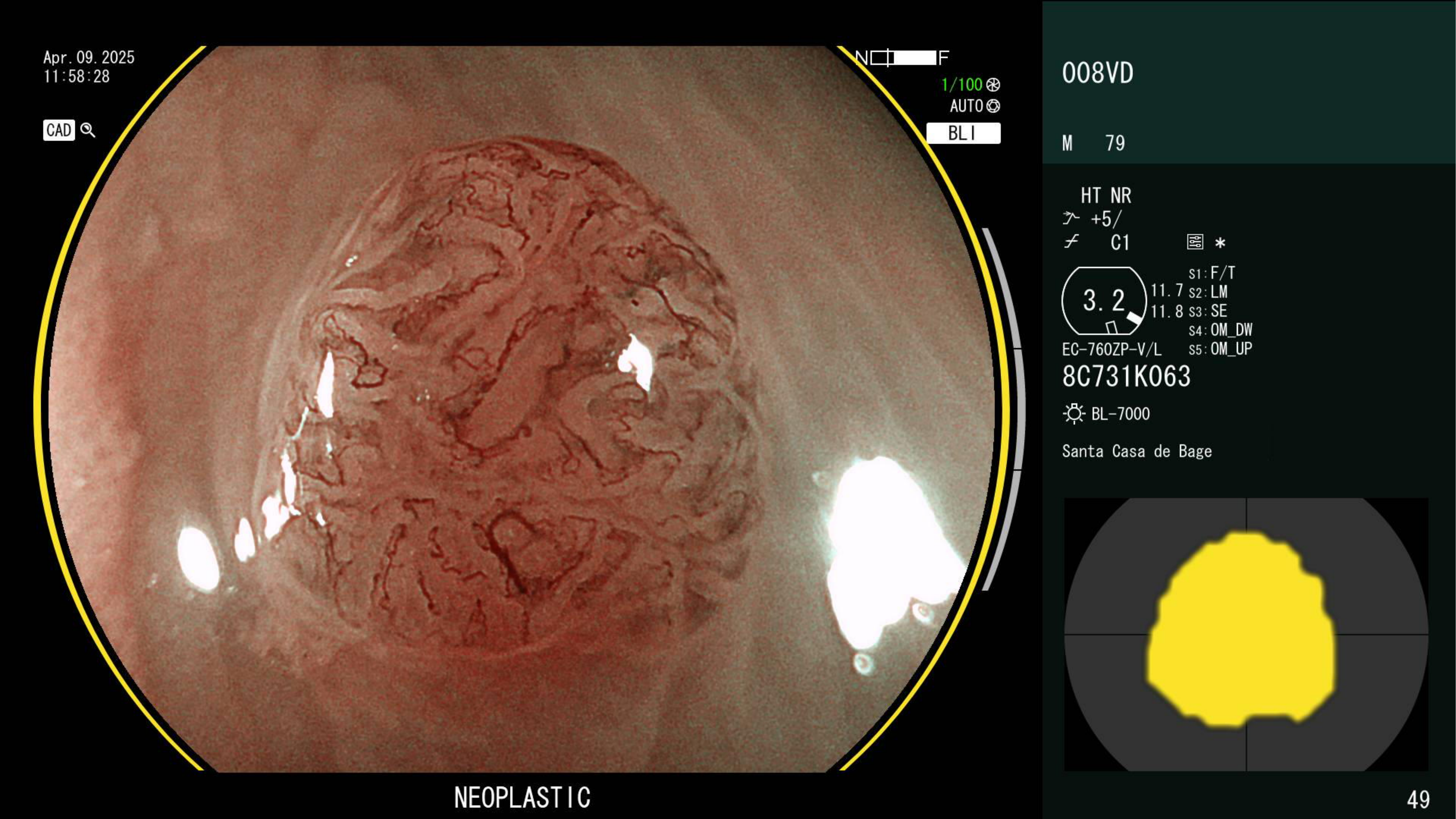
18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Santa Casa de Bage
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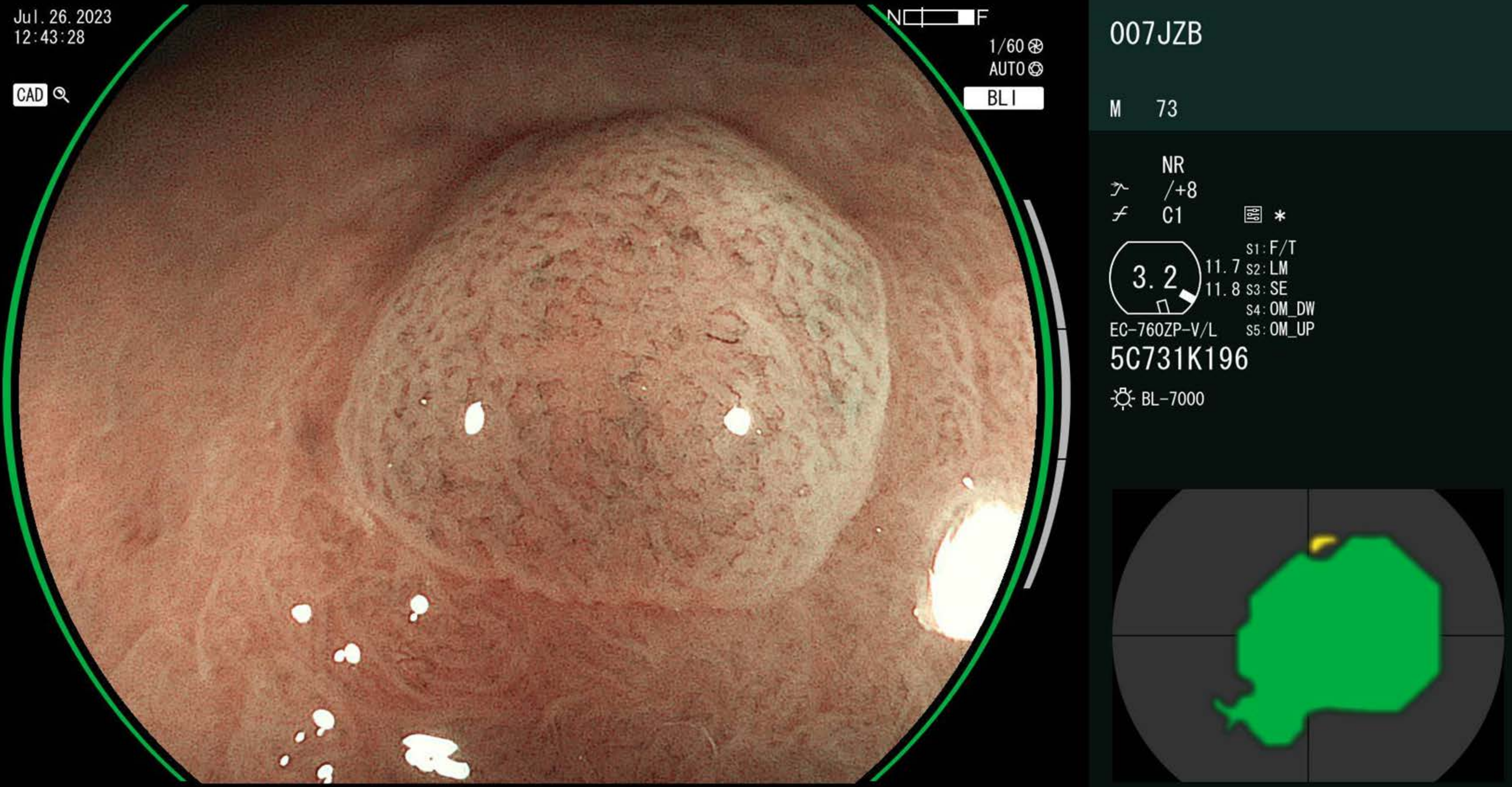
Santa Casa de Bage
Dr.Carlos Eduardo
HYPERPLASTIC
22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S1: F/T
S2: LM
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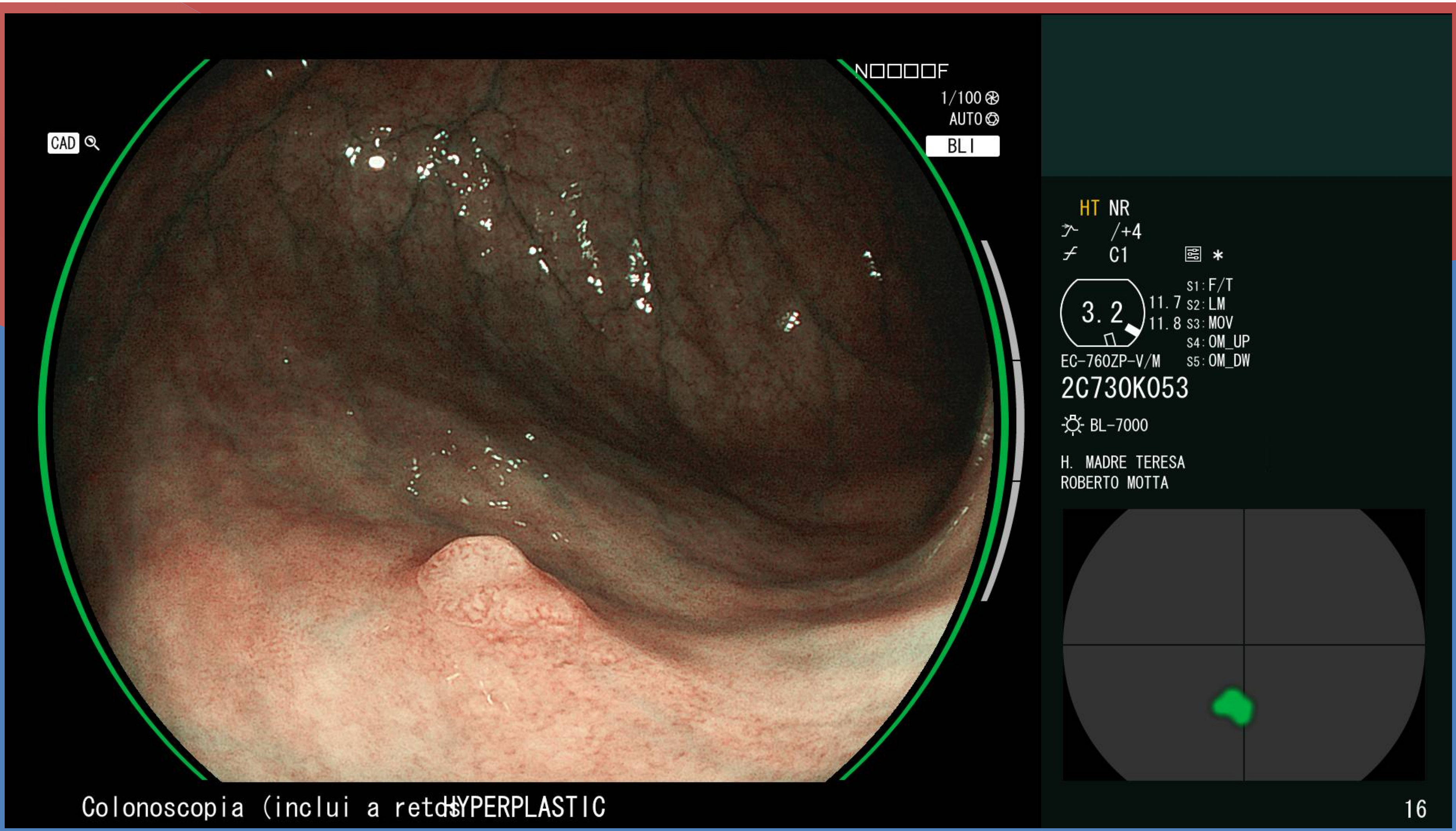
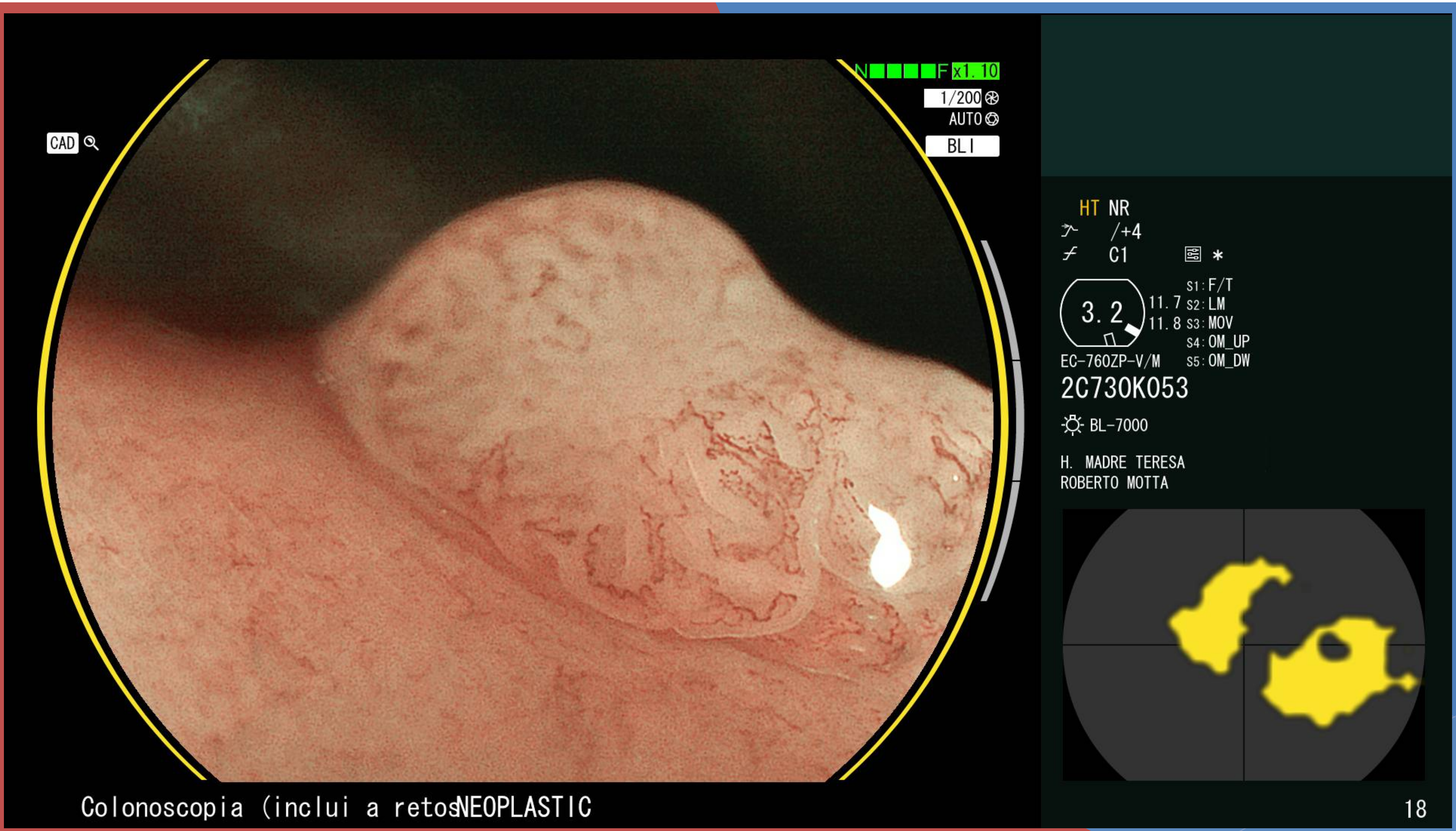
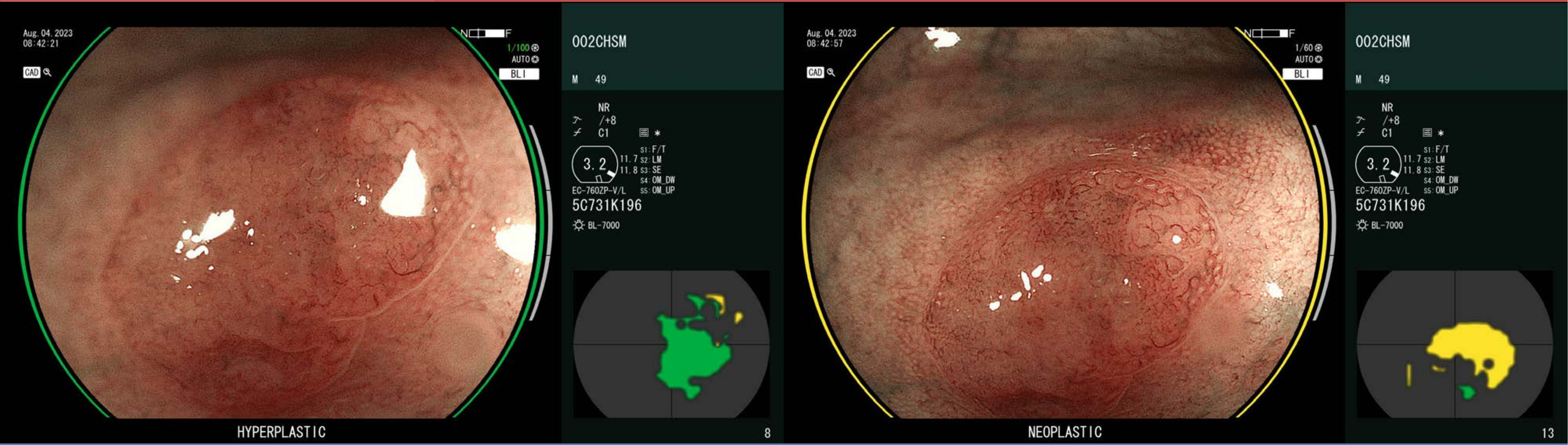
CHARACTERISATION SUPPORT



BLI CHARACTERISATION SUPPORT



BLI CHARACTERISATION SUPPORT



SCANDINAVIAN JOURNAL OF GASTROENTEROLOGY
https://doi.org/10.1080/00365521.2018.1501092

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ORIGINAL ARTICLE

Check for updates

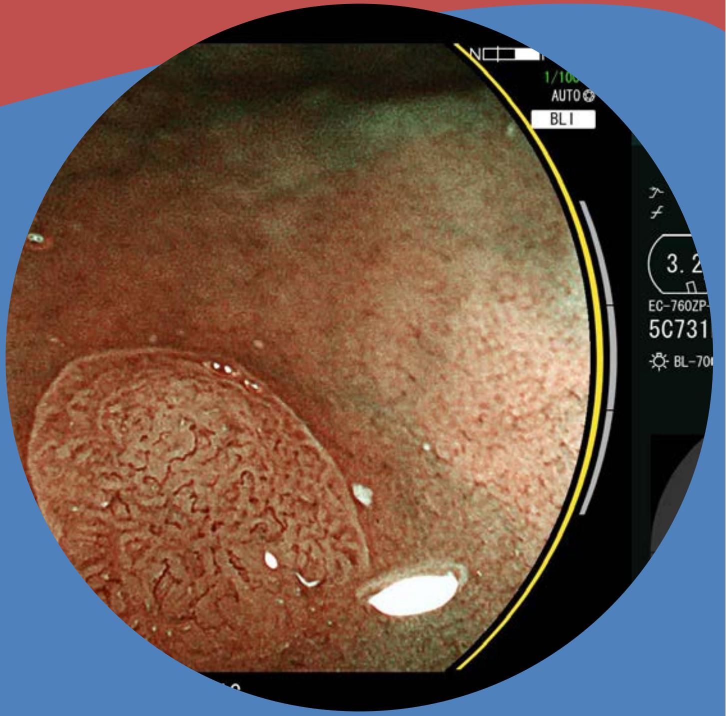
Optical classification of neoplastic colorectal polyps – a computer-assisted approach (the COACH study)

Janis Renner[a*], Henrik Phlipsen[a*], Bernhard Haller[b], Fernando Navarro-Avila[c], Yadira Saint-Hill-Febles[c], Diana Mateus[c], Thierry Ponchon[d], Alexander Poszler[a], Mohamed Abdelhafez[a], Roland M. Schmid[a], Stefan von Delius[e] and Peter Klare[a]

Table 3. CAOB and expert performance in the optical diagnosis of neoplastic polyps.

Factor	CAOB	Expert 1	Expert 2
Accuracy for neoplastic polyps	78.0% (78/100) [68.1% to 85.7%]	84.0% (84/100) [75.3% to 90.6%]	77.0% (77/100) [67.5% to 84.8%]
Sensitivity for neoplastic polyps	92.3% (48/52) [81.5% to 97.9%]	92.3% (48/52) [81.5% to 97.9%]	73.1% (38/52) [59.0% to 84.4%]
NPV for neoplastic polyps	88.2% (30/34) [72.6% to 88.2%]	90.0% (36/40) [76.3% to 97.2%]	73.6% (39/53) [59.7% to 84.7%]
Specificity for neoplastic polyps	62.5% (30/48) [47.4% to 76.1%]	75.0% (36/48) [60.4% to 86.4%]	81.3% (39/48) [67.4% to 91.1%]
PPV for neoplastic polyps	72.7% (48/66) [60.4% to 83.0%]	80.0% (48/60) [67.7% to 89.2%]	80.9% (38/47) [67.7% to 90.9%]
Accuracy for neoplastic polyps high-confidence predictions	80.9% (72/89) [71.2% to 88.5%]	86.9% (73/84) [77.8% to 93.3%]	82.1% (64/78) [71.7% to 89.8%]
Sensitivity for neoplastic polyps high-confidence predictions	93.9% (46/49) [83.1% to 98.7%]	93.8% (45/48) [82.3% to 98.7%]	80.5% (33/41) [65.1% to 91.2%]
NPV for neoplastic polyps high-confidence predictions	89.7% (26/29) [72.7% to 97.8%]	90.3% (28/31) [74.3% to 98.0%]	79.5% (31/39) [63.5% to 90.7%]
Specificity for neoplastic polyps high-confidence predictions	65.0% (26/40) [48.3% to 79.4%]	77.8% (28/36) [60.9% to 89.9%]	83.8% (31/37) [68.0% to 93.8%]
PPV for neoplastic polyps high-confidence predictions	76.7% (46/60) [64.0% to 86.6%]	84.9% (45/53) [72.4% to 93.3%]	84.6% (33/39) [69.5% to 94.1%]

Values are presented as % (n) unless otherwise noted. Second row in each column indicates 95% confidence interval.



International Journal of Colorectal Disease
https://doi.org/10.1007/s00384-021-04006-5

ORIGINAL ARTICLE

An analysis about the function of a new artificial intelligence, CAD EYE with the lesion recognition and diagnosis for colorectal polyps in clinical practice

Naohisa Yoshida[1] · Ken Inoue[1] · Yuri Tomita[1] · Reo Kobayashi[1] · Hikaru Hashimoto[1] · Satoshi Sugino[1] · Ryohei Hirose[1] · Osamu Dohi[1] · Hiroaki Yasuda[1] · Yukiko Morinaga[2] · Yutaka Inada[3] · Takaaki Murakami[4] · Xin Zhu[5] · Yoshito Itoh[1]

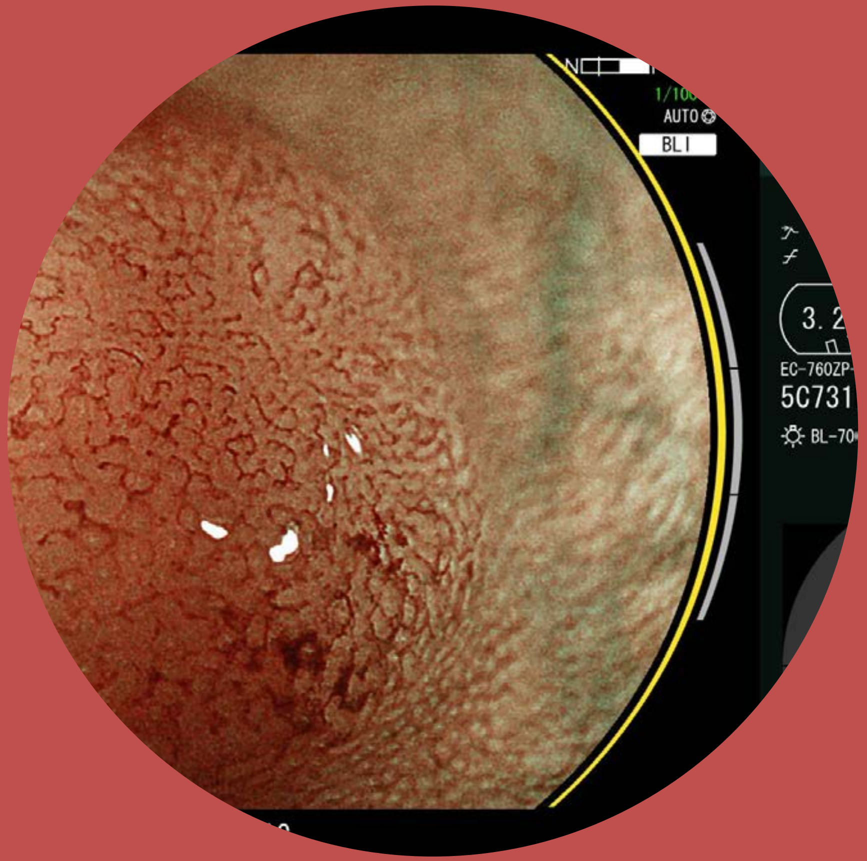


Table 3 The comparison of the diagnostic function between CAD EYE and endoscopists

	Sensitivity	Specificity	PPV	NPV	Accuracy
CAD EYE Magnified BLI ($N=98$)	90.9	85.2	83.3	92.0	87.8
CAD EYE Non-magnified BLI ($N=89$)	91.7	86.8	82.5	93.9	88.8
5 experts	93.3	90.9	89.4	94.3	92.0
5 trainees	82.2	76.4	74.0	79.0	79.0
P-value CAD EYE (magnified BLI) vs. Expert	0.56	0.20	0.23	0.52	0.17
P-value CAD EYE (magnified BLI) vs. Trainee	0.15	0.15	0.16	0.14	0.04

Original Article

Performance of artificial intelligence in the characterization of colorectal lesions

Carlos E. O. Dos Santos[1,2], Daniele Malaman[1], Ivan D. Arciniegas Sanmartin[3], Ari B. S. Leão[2], Gabriel S. Leão[2], Júlio C. Pereira-Lima[4]

74 pacientes; 110 lesões; PDR = 67.6%; ADR = 45.9%

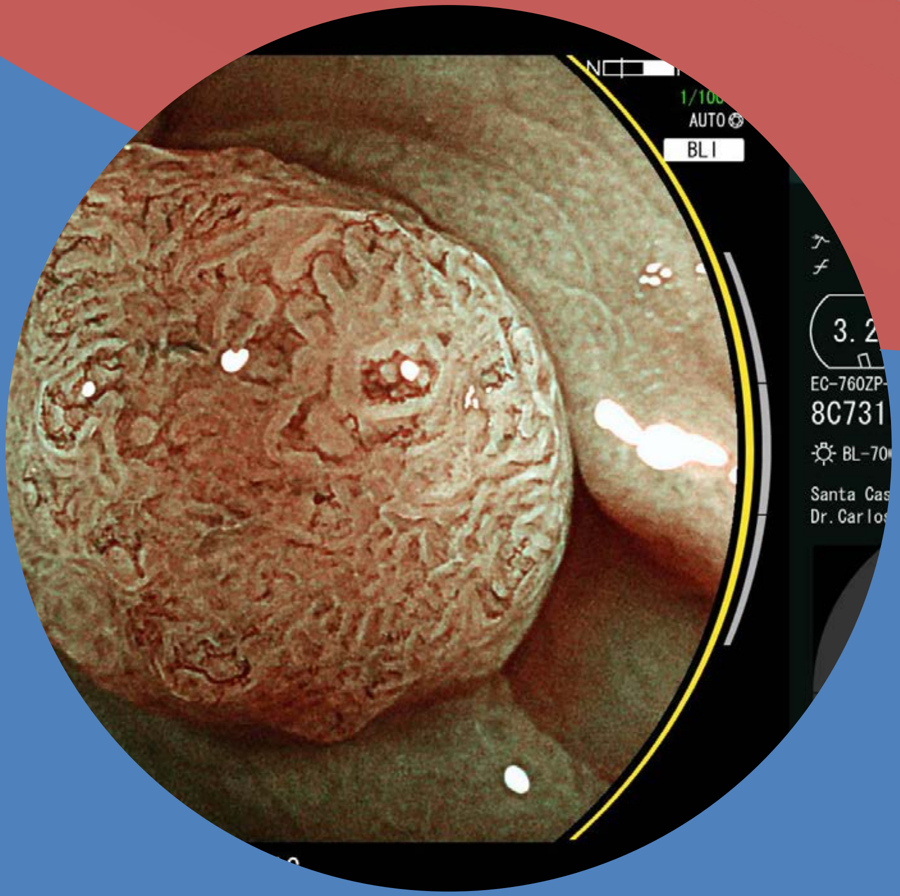
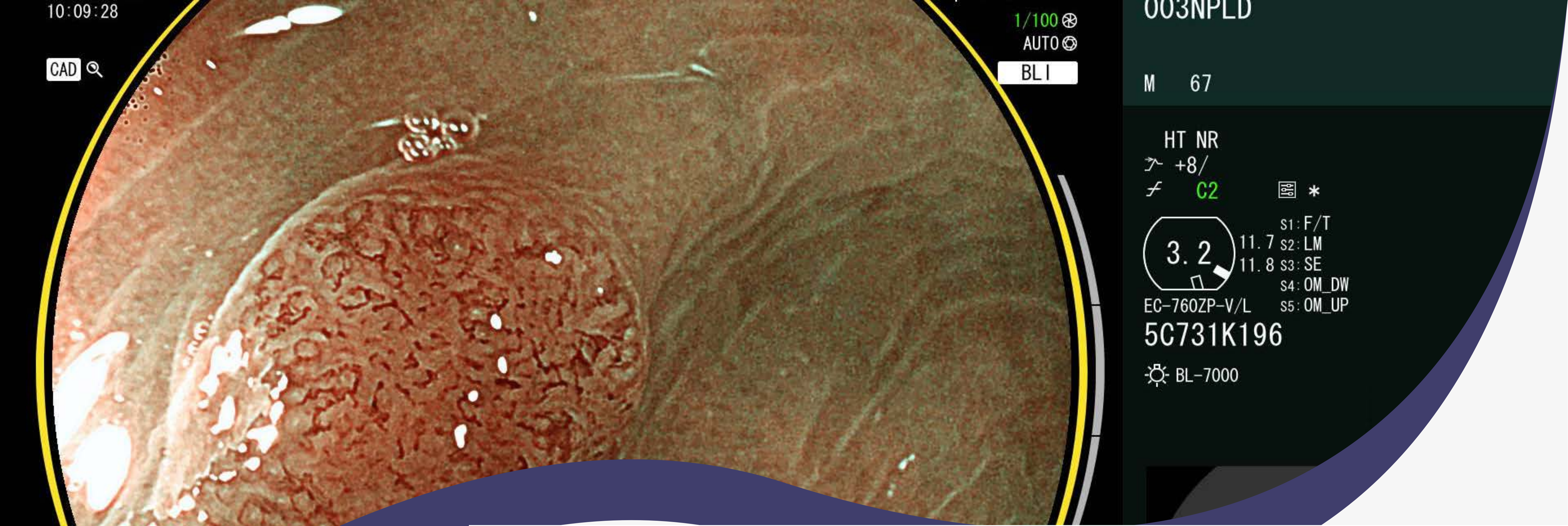


Table 2: Comparison of diagnostic performance between artificial intelligence and experts

Indicator	Artificial intelligence	Expert
Accuracy	81.8% (95% CI 78.8–84.8)	93.6% (95% CI 92.4–94.8)
Kappa	0.61 (0.47–0.76)	0.85 (0.74–0.96)
Sensitivity	76.3% (95% CI 65.4–85.1)	92.5% (95% CI 84.4–97.2)
Specificity	96.7% (95% CI 82.8–99.9)	96.7% (95% CI 82.8–99.9)
PPV	98.4% (95% CI 91.3–100.0)	98.7% (95% CI 92.8–100.0)
NPV	60.4% (95% CI 45.3–74.2)	82.9% (95% CI 66.4–93.4)
AUC	0.87 (0.81–0.92)	0.95 (0.90–0.99)

PPV: Positive predictive value, NPV: Negative predictive value, AUC: Area under the ROC curve. When comparing the two performances, the accuracy, kappa, sensitivity, NPV, and AUC values of the expert were superior to those of artificial intelligence ($P<0.01$)



Indicator	Artificial intelligence	Expert	p-value
Accuracy	92.1% (90.2; 94.0)	93.6% (91.9; 95.3)	≥0.05
Kappa (IC95%)	0.76 (0.70; 0.82)	0.80 (0.75; 0.85)	<0.05
Sensitivity	94.7% (92.6; 96.3)	96.3% (94.5; 97.6)	≥0.05
Specificity	81.8% (74.9; 87.4)	83.0% (76.3; 88.5)	≥0.05
Positive predictive value	95.3% (93.3; 96.8)	95.7% (93.8; 97.1)	≥0.05
Negative predictive value	79.8% (72.8; 85.6)	85.2% (78.6; 90.4)	<0.05
Area under ROC curve	0.88 (0.85; 0.91)	0.90 (0.87; 0.92)	≥0.05

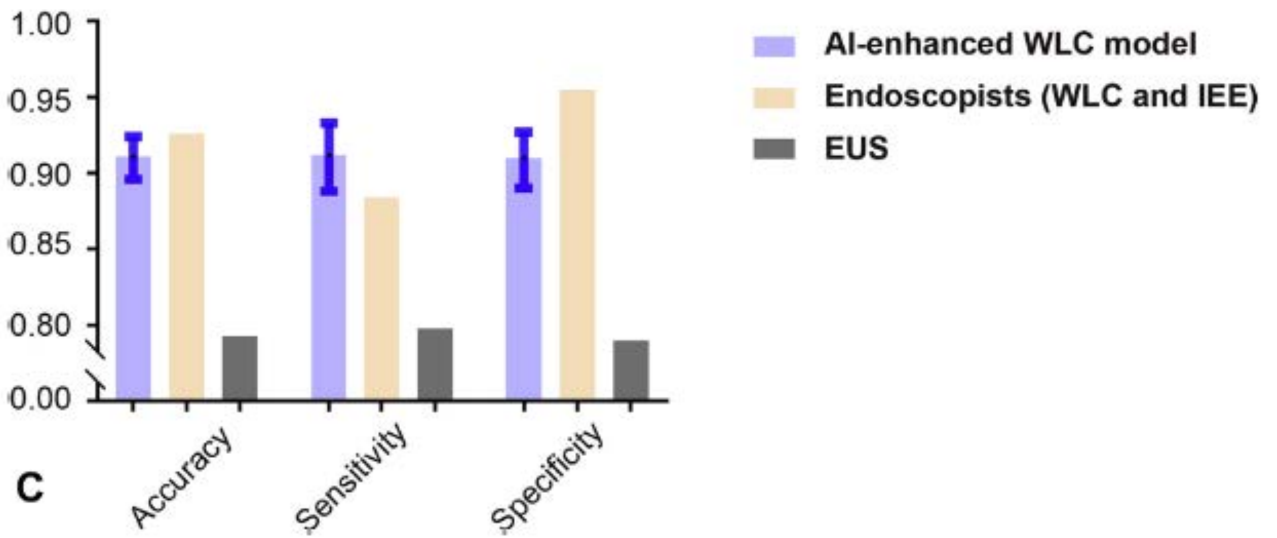
ORIGINAL ARTICLE: Clinical Endoscopy

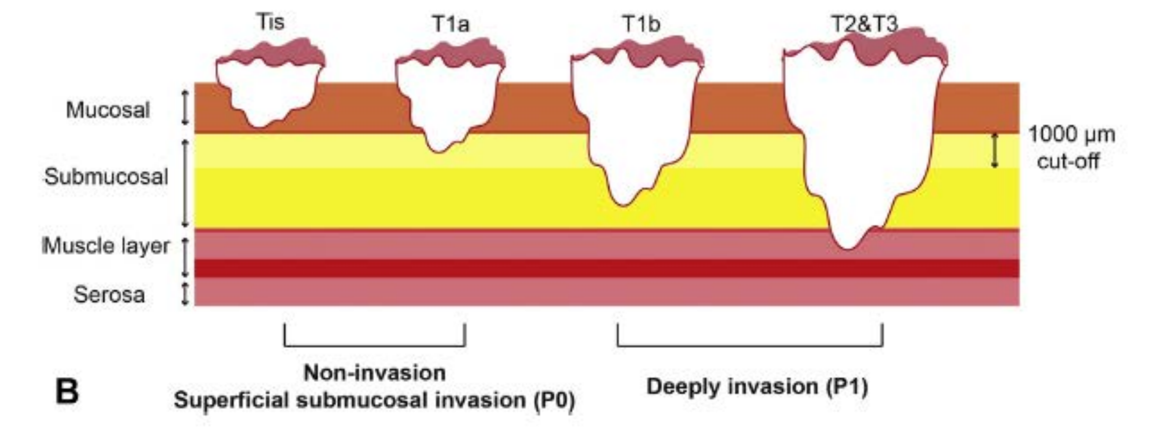
Artificial intelligence–enhanced white-light colonoscopy with attention guidance predicts colorectal cancer invasion depth

Xiaobei Luo, PhD, MD,[1,*] Jiahao Wang, Bachelor of science,[2,3,*] Zelong Han, PhD, MD,[1,*] Yang Yu, PhD,[2,3,4] Zhenyu Chen, BEng,[1] Feiyang Huang, BS,[3] Yumeng Xu, MS,[2] Jianqun Cai, PhD, MD,[1] Qiang Zhang, MD,[1] Weiguang Qiao, PhD, MD,[1] Inn Chuan Ng, PhD,[5] Robby T. Tan, PhD,[6,7] Side Liu, PhD, MD,[1] Hanry Yu, PhD[1,2,3,4,5]

TABLE 2. Comparison of the artificial intelligence–enhanced colonoscopy model with endoscopists

	Artificial intelligence	Endoscopists	EUS
P0 vs P1			
Accuracy, %	91.1 (89.6-92.4)	92.6 (90.5-94.4)	79.3 (73.6-84.2)
Sensitivity, %	91.2 (88.8-93.3)	88.4 (84.3-91.8)	79.8 (69.6-87.8)
Specificity, %	91.0 (89.0-92.7)	95.5 (93.2-97.2)	79.0 (71.8-85.1)
PPV, %	87.6	93.2	67.0
NPV, %	93.7	92.2	88.0
AUROC curve	.970 (.962-.978)	.905 (.884-.926)	.794 (.734-.854)





> Lancet Digit Health. 2022 Jun;4(6):e436-e444. doi: 10.1016/S2589-7500(22)00042-5. Epub 2022 Apr 13.

Cost-effectiveness of artificial intelligence for screening colonoscopy: a modelling study

Miguel Areia [1], Yuichi Mori [2], Loredana Correale [3], Alessandro Repici [4], Michael Bretthauer [5], Prateek Sharma [6], Filipe Taveira [7], Marco Spadaccini [4], Giulio Antonelli [8], Alanna Ebigbo [9], Shin-Ei Kudo [10], Julia Arribas [11], Ishita Barua [12], Michal F Kaminski [13], Helmut Messmann [9], Douglas K Rex [14], Mário Dinis-Ribeiro [15], Cesare Hassan [4]

Methods: We conducted Markov model microsimulation of using colonoscopy with and without AI for colorectal cancer screening for individuals at average risk (no personal or family history of colorectal cancer, adenomas, inflammatory bowel disease, or hereditary colorectal cancer syndrome). We ran the microsimulation in a hypothetical cohort of 100 000 individuals in the USA aged 50-100 years. The primary analysis investigated screening colonoscopy with versus without AI every 10 years starting at age 50 years and finishing at age 80 years, with follow-up until age 100 years, assuming

Findings: In the primary analyses, compared with no screening, the relative reduction of colorectal cancer incidence with screening colonoscopy without AI tools was 44·2% and with screening colonoscopy with AI tools was 48·9% (4·8% incremental gain). Compared with no screening, the relative reduction in colorectal cancer mortality with screening colonoscopy with no AI was 48·7% and with screening colonoscopy with AI was 52·3% (3·6% incremental gain). AI detection tools decreased the discounted costs per screened individual from $3400 to $3343 (a saving of $57 per individual). Results were similar in the secondary analyses modelling once-in-life colonoscopy. At the US population level, the implementation of AI detection during screening colonoscopy resulted in yearly additional prevention of 7194 colorectal cancer cases and 2089 related deaths, and a yearly saving of US$290 million.

> Gastrointest Endosc. 2020 Feb;91(2):428-435.e2. doi: 10.1016/j.gie.2019.11.026. Epub 2019 Nov 26.

A novel artificial intelligence system for the assessment of bowel preparation (with video)

Jie Zhou [1], Lianlian Wu [1], Xinyue Wan [1], Lei Shen [1], Jun Liu [2], Jun Zhang [1], Xiaoda Jiang [1], Zhengqiang Wang [1], Shijie Yu [1], Jian Kang [1], Ming Li [1], Shan Hu [3], Xiao Hu [3], Dexin Gong [1], Di Chen [1], Liwen Yao [1], Yijie Zhu [1], Honggang Yu [1]

Results: ENDOANGEL achieved 93.33% accuracy in the human-machine contest with 120 images, which was better than that of all endoscopists. Moreover, ENDOANGEL achieved 80.00% accuracy among 100 images with bubbles. In 20 colonoscopy videos, the accuracy was 89.04%, and ENDOANGEL continuously showed the accumulated percentage of the images for different BBPS scores during the withdrawal phase and prompted us for bowel preparation scores every 30 seconds.

J Gastroenterol Hepatol. 2024 Sep;39(9):1917-1923. doi: 10.1111/jgh.16618. Epub 2024 May 20.

Automatic assessment of bowel preparation by an artificial intelligence model and its clinical applicability

Ji Young Lee [1], Jooyoung Park [2], Hyo Jeong Lee [1], Hana Park [1], Eun Hyo Jin [3], Kanggil Park [2], Ji Eun Baek [4], Dong-Hoon Yang [4], Seung Wook Hong [4], Namkug Kim [2], Jeong-Sik Byeon [4]

Results: The AI model achieved an accuracy of 94.0% and an area under the receiver operating characteristic curve of 0.939 with the still images. Model testing with an external dataset showed an accuracy of 95.3%, an area under the receiver operating characteristic curve of 0.976, and a sensitivity of 100% for the detection of inadequate preparations. The clinical applicability study showed an overall agreement rate of 85.3% between endoscopists and the AI model, with Fleiss' kappa of 0.686. The agreement rate was lower for the right colon compared with the transverse and left colon, with Fleiss' kappa of 0.563, 0.575, and 0.789, respectively.

> Dig Endosc. 2022 Sep;34(6):1188-1195. doi: 10.1111/den.14318. Epub 2022 May 19.

Artificial intelligence-based measurement outperforms current methods for colorectal polyp size measurement

Min Seob Kwak [1], Jae Myung Cha [1], Jung Won Jeon [1], Jin Young Yoon [1], Jong Wook Park [1]

For both experts and trainees, visually estimated sizes of the same polyp were significantly inconsistent ($p< 0.001$).

It was a trend toward underestimation of the sizes of the polyps in both groups, especially for polyps larger than 10 mm.

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It was a trend toward underestimation of the sizes of the polyps in both groups, especially for polyps larger than 10 mm.

The new technique was highly accurate and reliable in measuring the size of colon polyp (CCC, 0.961; confidence interval 0.926-0.979), clearly outperforming the visual estimation and open biopsy forceps methods.

Conclusion: The new AI measurement method improved the accuracy and reliability of polyp size measurements in colonoscopy images.

A real-time deep learning-based system for colorectal polyp size estimation by white-light endoscopy: development and multicenter prospective validation

Endoscopy. 2024 Apr;56(4):260-270.

Jing Wang [#, 1, 2, 3, 4], Ying Li [#, 5], Boru Chen [1, 2, 3, 4], Du Cheng [1, 2, 3, 4], Fei Liao [1, 2, 3, 4], Tao Tan [6], Qinghong Xu [5], Zhifeng Liu [6], Yuan Huang [5], Ci Zhu [5], Wenbing Cao [5], Liwen Yao [1, 2, 3, 4], Zhifeng Wu [1, 2, 3, 4], Lianlian Wu [1, 2, 3, 4], Chenxia Zhang [1, 2, 3, 4], Bing Xiao [1, 2, 3, 4], Ming Xu [1, 2, 3, 4], Jun Liu [1, 2, 3, 4], Shuyu Li [#, 6], Honggang Yu [#, 1, 2, 3, 4]

Results: The relative error of depth estimation was 11.3% (SD 6.0%) in successive virtual colon images. The concordance correlation coefficients (CCCs) between system estimation and ground truth were 0.89 and 0.93 in images of a simulated colon and multicenter videos of 157 polyps. The mean CCC of ENDOANGEL-CPS surpassed all endoscopists (0.89 vs. 0.41 [SD 0.29]; $P<0.001$). The relative accuracy of ENDOANGEL-CPS was significantly higher than that of endoscopists (89.9% vs. 54.7%; $P<0.001$). Regarding inappropriate surveillance recommendations, the system's error rate is also lower than that of endoscopists (1.5% vs. 16.6%; $P<0.001$).

Artificial intelligence-based assessments of colonoscopic withdrawal technique: a new method for measuring and enhancing the quality of fold examination

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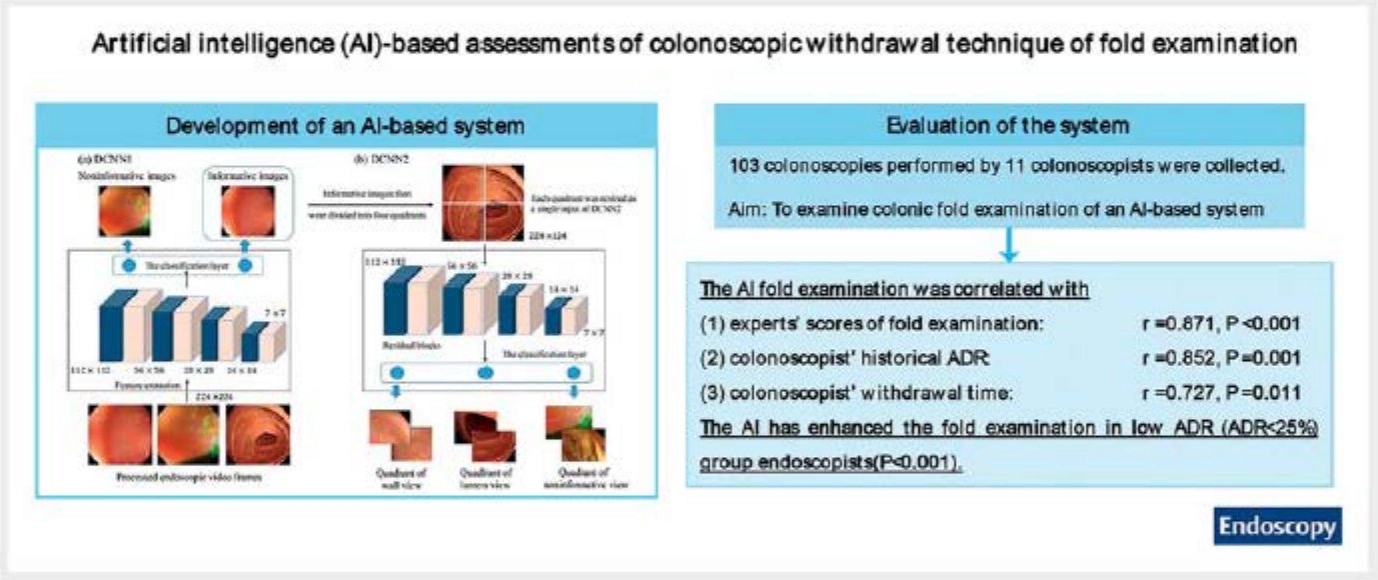

Authors

Wei Liu[1,*], Yu Wu[2,*], Xianglei Yuan[1], Jingyu Zhang[3], Yao Zhou[2], Wanhong Zhang[4], Peipei Zhu[5], Zhang Tao[6], Long He[1], Bing Hu[1], Zhang Yi[2]

REVIEW
2025 May 27 [Epub ahead of print]
https://doi.org/10.5946/ce.2025.022
pISSN: 2234-2400 • eISSN: 2234-2443
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CLINICAL ENDOSCOPY

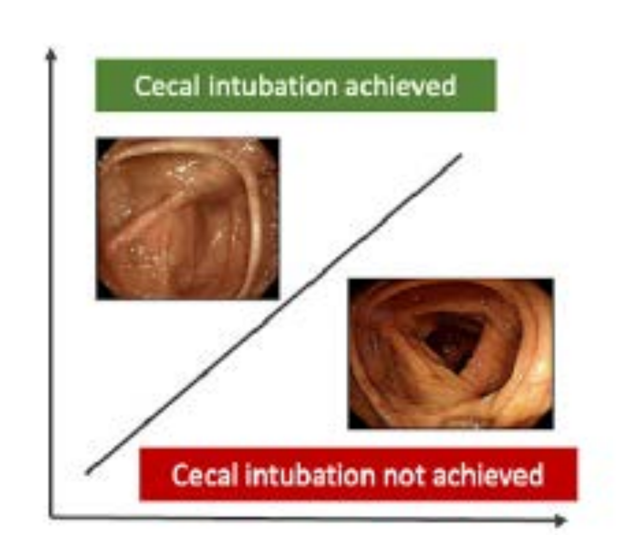
Clinical significance of computer-aided quality assessment systems in colonoscopy: a comprehensive review

Wai Phyo Lwin[1,2*], Katsuro Ichimasa[1,3,*], Shin-Ei Kudo[1], Yuta Kouyama[1], Taishi Okumura[1], Yasuharu Maeda[1], Yutaro Ide[1], Khay Guan Yeoh[3], Masashi Misawa[1]

FOLD EXAMINATION QUALITY

CECAL INTUBATION

- Increased detection of adenomas (OR 1.35) and advanced adenomas (OR 1.23)
- No improvement in cecal intubation rates



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WITHDRAWAL SPEED

- Proportion of overspeed frames (POF) – promisora métrica de calidad
- ADR was higher in the group with POF ≤10% than that in the group with POF >10% (*p*<0.01)

EFFECTIVE WITHDRAWAL TIME

- Defined as frames with a clear view of the colonic wall or lumen
- 49% ADR increase for each additional minute of EWT

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BOWEL PREPARATION QUALITY ASSESSMENT

- Accuracy of 95.15%
- Improved bowel preparation quality (*p*<0.001)
- No difference in the ADR (*p*=0.189) or PDR (*p*=0.223)

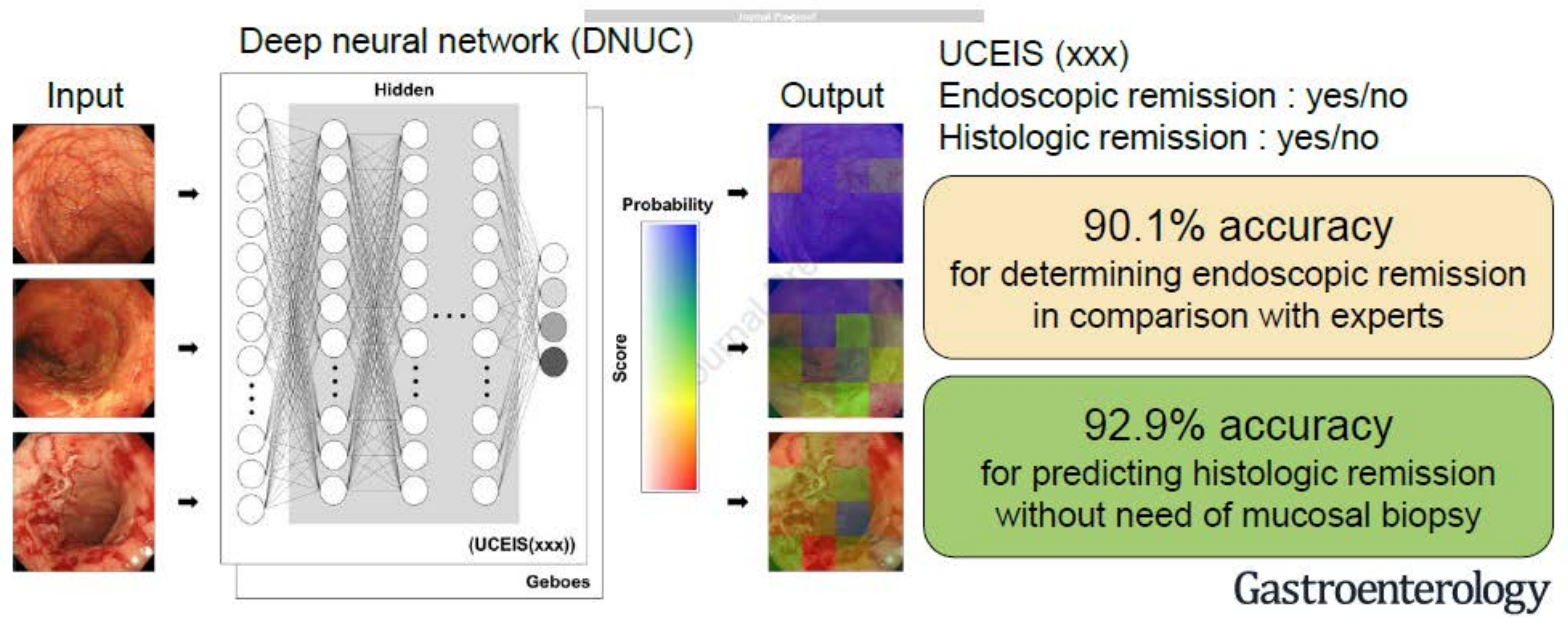
Zhu Y et al. NPJ Digit Med 2023;6:41.

- Higher BBPS scores (*p*=0.001) and PDR (*p*=0.020)

Zhong H et al. Scand J Gastroenterol 2025;60:116–121.

Development and Validation of a Deep Neural Network for Accurate Evaluation of Endoscopic Images From Patients with Ulcerative Colitis

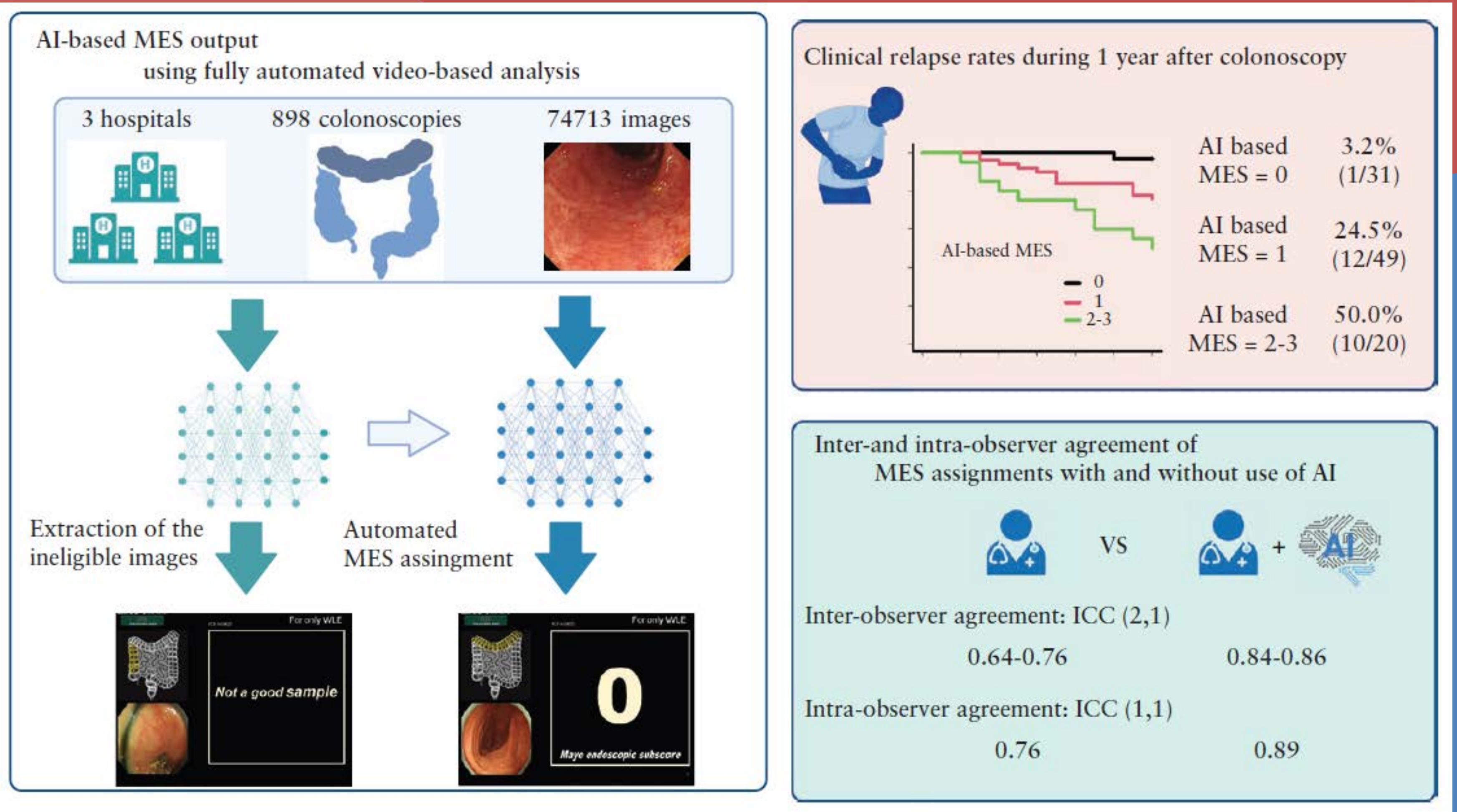
Kento Takenaka, PhD, Kazuo Ohtsuka, PhD, Toshimitsu Fujii, PhD, Mariko Negi, PhD, Kohei Suzuki, PhD, Hiromichi Shimizu, PhD, Shiori Oshima, PhD, Shintaro Akiyama, PhD, Maiko Motobayashi, MD, Masakazu Nagahori, PhD, Eiko Saito, PhD, Katsuyoshi Matsuoka, PhD, Mamoru Watanabe, PhD



Artificial Intelligence-assisted Video Colonoscopy for Disease Monitoring of Ulcerative Colitis: A Prospective Study

Noriyuki Ogata,[a,*] Yasuharu Maeda,[a,b,*], Masashi Misawa,[a,*] Kento Takenaka,[c] Kaoru Takabayashi,[d] Marietta Iacucci,[b] Takanori Kuroki,[a] Kazumi Takishima,[a] Keisuke Sasabe,[a] Yu Niimura,[a] Jiro Kawashima,[a] Yushi Ogawa,[a] Katsuro Ichimasa,[a] Hiroki Nakamura,[a] Shingo Matsudaira,[a] Seiko Sasanuma,[a] Takemasa Hayashi,[a] Kunihiko Wakamura,[a] Hideyuki Miyachi,[a] Toshiyuki Baba,[a] Yuichi Mori,[a,e] Kazuo Ohtsuka,[c,f] Haruhiko Ogata,[d,g,h] Shin-ei Kudo[a]

Journal of Crohn's and Colitis, 2025,



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Journal of Crohn's and Colitis, 2025,

Table 3 Diagnostic ability of the AI-based MES system.

Diagnosis	Sensitivity	Specificity	Accuracy	PPV	NPV
Image appropriate for scoring [*n* = 11,472]	83.0 [81.8–84.2] [3378/4069]	86.3 [85.5–87.0] [6386/7403]	85.1 [84.4–85.8] [9764/11,472]	76.9 [75.6–78.1] [3378/4395]	90.2 [89.5–90.9] [6386/7077]
Endoscopic remission [*n* = 4395]	96.9 [96.2–97.4] [3453/3565]	78.4 [75.5–81.2] [651/830]	93.4 [92.6–94.1] [4104/4395]	95.1 [94.3–95.8] [3453/3565]	85.3 [82.6–87.8] [651/763]
Complete endoscopic remission [*n* = 4395]	93.8 [92.8–94.7] [2462/2626]	77.2 [75.2–79.2] [1366/1769]	87.1 [86.1–88.1] [3828/4395]	85.9 [84.6–87.2] [2462/2865]	89.3 [87.6–90.8] [1366/1530]

Values given as % [95% confidence interval] [*n*/*N*].
MES, Mayo Endoscopic Subscore; PPV, positive predictive value; NPV, negative predictive value.


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Linked-color imaging with o
adenoma detection: a rando
Table 3 Adenoma detection with linked-color imaging
LCA (n = 400)
ADR, n (%) [95%CI]
235 (58.8) [53.8 to 63.6]
ADR in experts
145/258 (56.2) [49.9 to 62.3]
ADR in trainees
90/142 (63.4) [54.9 to 71.3]
Relative risk [95%CI] (vs. LCI)
ADR
1.351 [1.176 to 1.551]
ADR in experts
1.216 [1.024 to 1.444]
ADR in trainees
1.628 [1.285 to 2.063]
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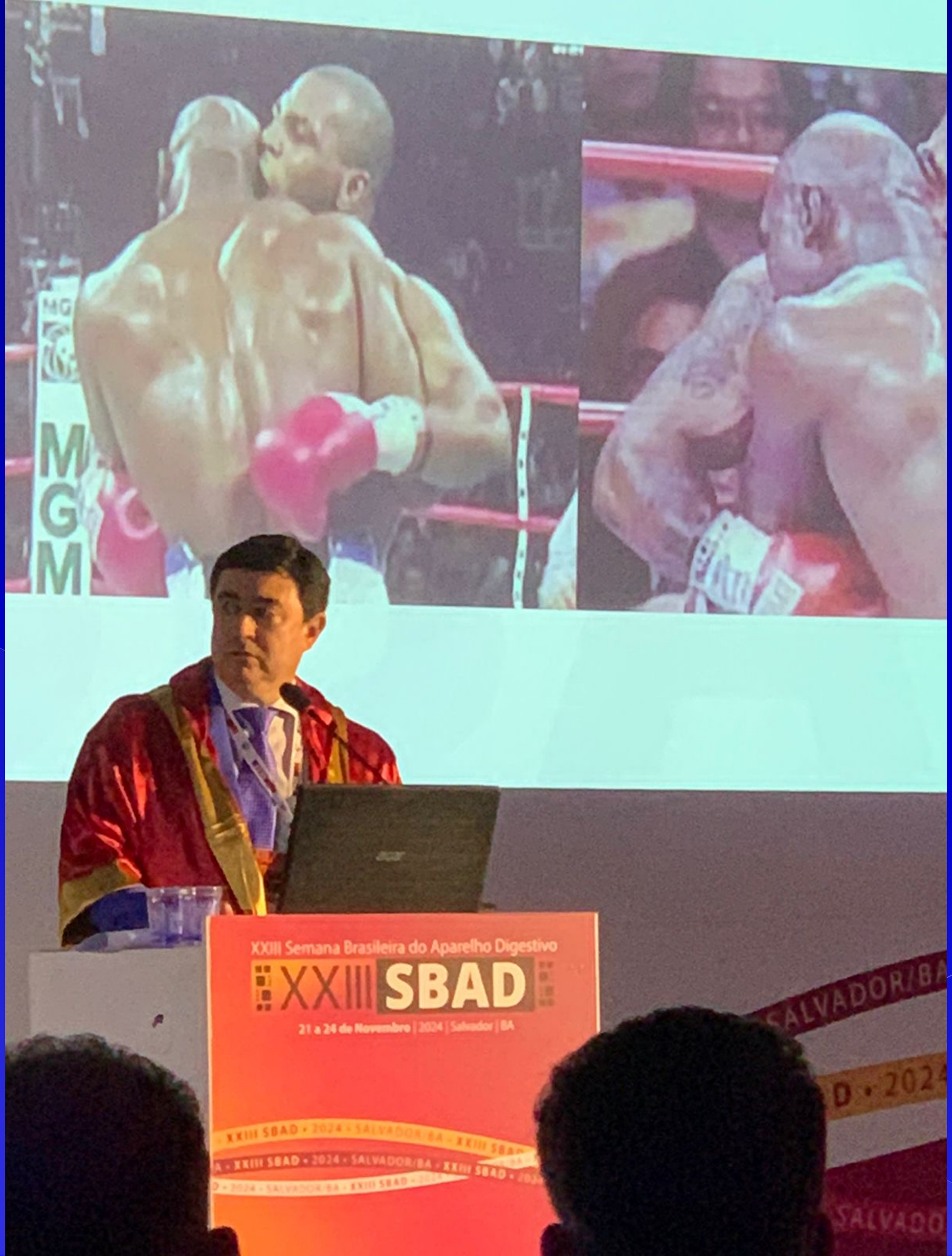
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