What’s new in CRC screening? …AI…

Emanuele Rondonotti, MD, PhD

UOC Gastroenterologia, Ospedale Valduce, Como.

AI for Colonoscopy:

- Detection (CADe)
- Characterization (CADx)
- Inflammatory scoring (IBD)
- Quality of bowel prep
- Report drafting/analysis
- CIR calculation
- Polyp sizing…

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- Polyp sizing …

CADe

Effective in increasing polyp detection

CADe increases ADR

Author, journal, year	N. of papers	Results (95%CI)
Hassan C, GIE 2021	5	**ADR** RR: 1.44 (1.27-1.62)
Barua I, Endoscopy 2021	5	**ADR** RR: 1.52 (1.31-1.77)
Li J, Eur J GH 2021	5	**ADR** RR: 1.75 (1.52-2-.01)
Zhang Y, J Laparoendosc Adv Surg Tech A, 2021	7	**ADR** OR: 1.72 (1.52-1.95)
Xu Y, PlosOne 2021	7	**PDR** AUC: 0.98 (0.96-0.99)
Ashat M, Endosc Int Open 2021	6	**ADR** OR: 1.76 (1.55-2.00)
Deliwala SS, Int J Colorect Dis 2021	6	**ADR** OR: 1.77 (1.57-2.08)
Nazarin S, J Med Int Res 2021	8	**ADR** OR**:** 1.53 (1.32-1.77)
Huang D, Int J Colorectal Dis 2022	10	**ADR** RR: 1.43 (p<0.001)

Limitations: Mostly experts endoscopists, limited number of patients, Vs white light, patient **heterogeneity.**

Endoscopy

ORIGINAL ARTICLE

Full-spectrum (FUSE) versus standard forward-viewing colonoscopy in an organised colorectal cancer screening programme

Cesare Hassan,[1] Carlo Senore,[2] Franco Radaelli,[3] Giovanni De Pretis,[4] Romano Sassatelli,[5] Arrigo Arrigoni,[6] Gianpiero Manes,[7] Arnaldo Amato,[3] Andrea Anderloni,[8] Franco Armelao,[4] Alessandra Mondardini,[6] Cristiano Spada,[9] Barbara Omazzi,[7] Maurizio Cavina,[5] Gianni Miori,[4] Chiara Campanale,[9] Giuliana Sereni,[5] Nereo Segnan,[2] Alessandro Repici[8,10]

Hassan C, *et al*. *Gut* 2017;**66**:1949–1955. doi:10.1136/gutjnl-2016-311906

Adenoma detection by Endocuff-assisted versus standard colonoscopy in an organized screening program: the "ItaVision" randomized controlled trial

Authors

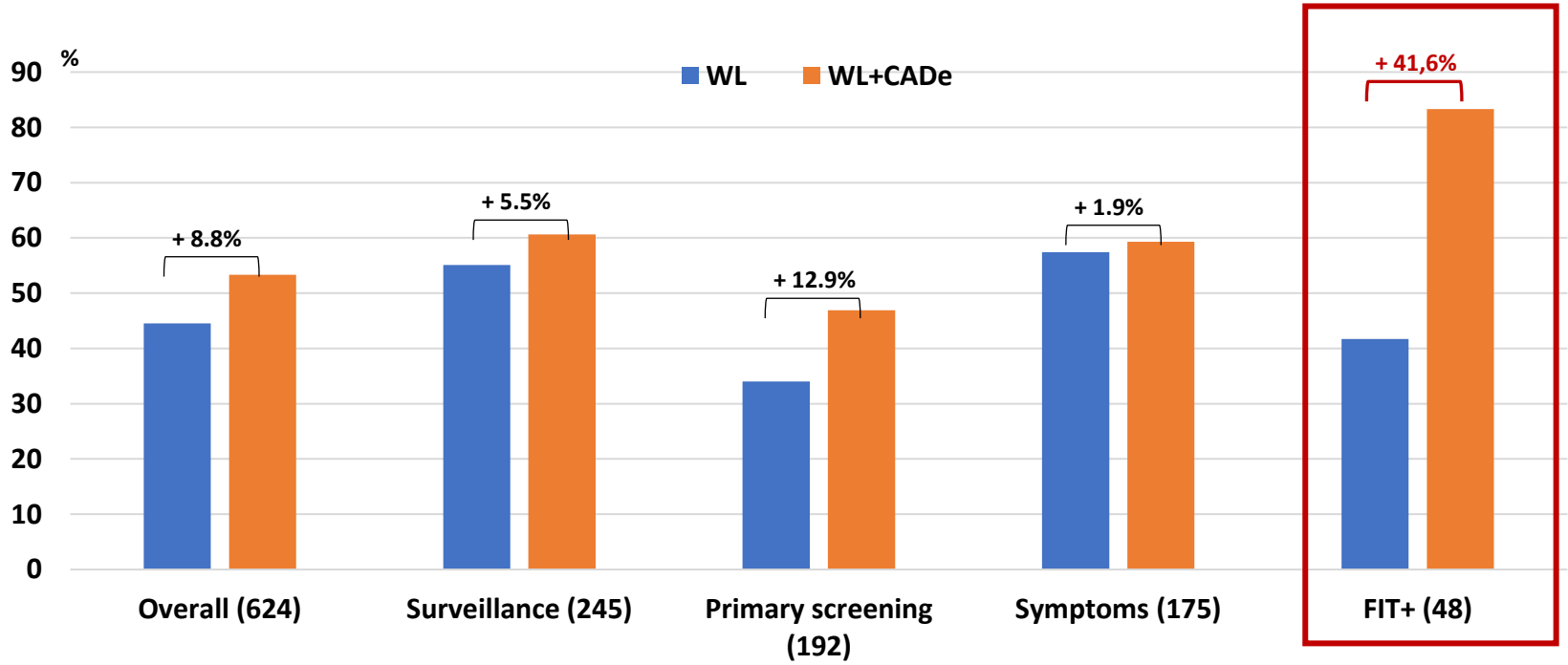
Manuel Zorzi[1], Cesare Hassan[2], Jessica Battagello[1], Giulio Antonelli[2,3,4], Maurizio Pantalena[5], Gianmarco Bulighin[6], Saverio Alicante[7], Tamara Meggiato[8], Erik Rosa-Rizzotto[9], Federico Iacopini[4], Carmelo Luigiano[10], Fabio Monica[11], Arrigo Arrigoni[12], Bastianello Germanà[13], Flavio Valiante[14], Beatrice Mallardi[15], Carlo Senore[16], Grazia Grazzini*[,15], Paola Mantellini[15], and the ItaVision Working Group

ItaVision Working Group

Angelo Bellumat[14], Andrea Buda[14], Elisabetta Buscarini[7], Lucas Cavallaro[13], Aldo Ceriani[8], Franca De Lazzari[9], Angelo Dezi[2], Ennio Guido[9], Giuseppe Iabichino[10], Claudio Londoni[7], Nicoletta Merlini[5], Francesca Murer[5], Neri Nardini[15], Ephrem Ntakirutimana[6], Emma Paulon[11], Anna Rostello[6], Marco Silvani[16], Nicoletta Stefani[11], Paolo Viaggi[10]

Effective in increasing polyp detection

AID-2 study



Repici A; Gut 2022; 71: 757-765

Effective in increasing polyp detection

CADe increases ADR in FIT-based CCR program

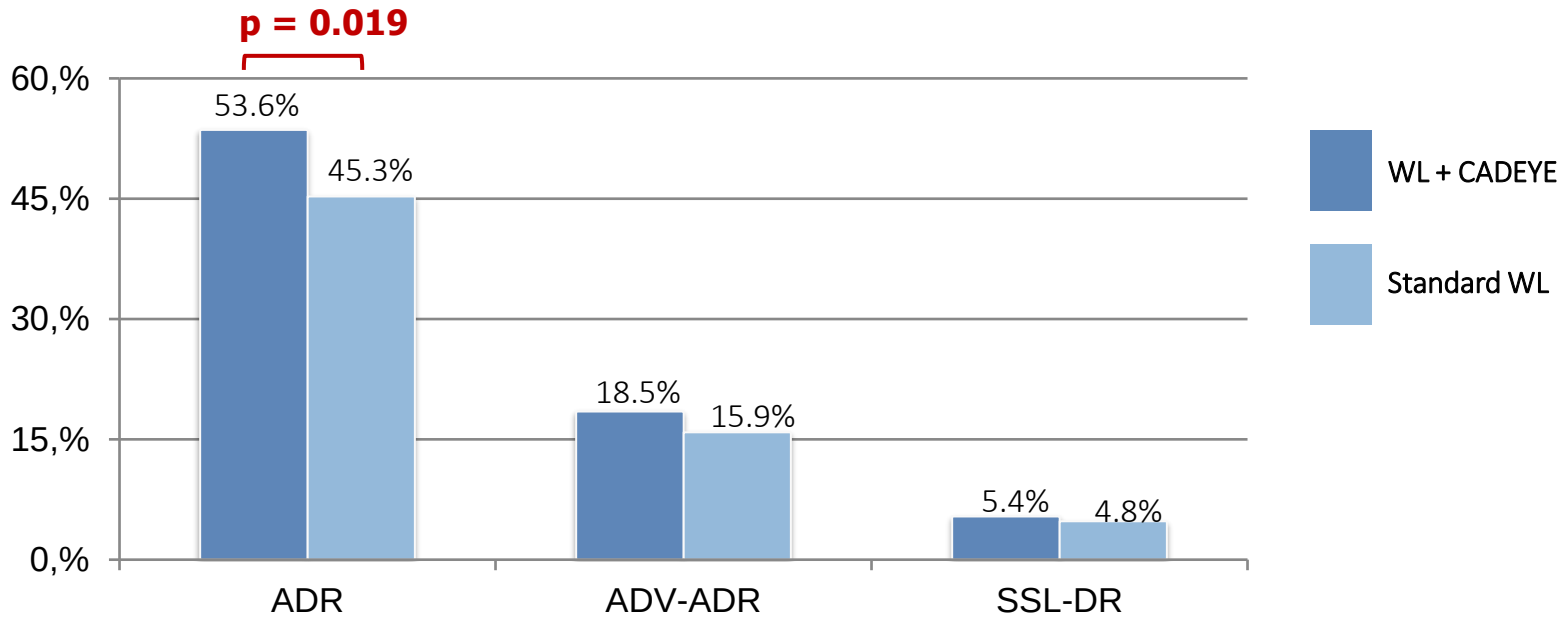
- **Design:** prospective multicenter parallel RCT
- **Centres:** Milano, Como, Pavia, Padova, Crema
- **Patients:** FIT+ (CRC screening program)
- **Arms:** HD-WL colonoscopy vs HD-WL-AI colonoscopy
- **AI system:** CAEYE™ (Fujifilm Co.)
- **Hypothesis, main outcome:** Ai increases in (43% → 53%)
- **Sample size:** 778 patients

	WL+CADe	Standard WL	p value
Enrolled patients	405	395	---
Mean age, SD	61.4, 7.0	61.1,7.5	0.464
Gender, Males (%)	52.6	49.6	0.437
First FIT round (%)	34.6	35.7	0.767
Overall BBPS 6-7 8-9	 131 274	 112 283	 0 248
Insertion time, mean (SD)	456.1 (245.2)	502.7 (638.2)	0.174
Mucosa inspection time, mean (SD)	572.2 (168.2)	568.6 (190.8)	0.403

Rondonotti E et al, Endoscopy 2022 [Epub]

Effective in increasing polyp detection

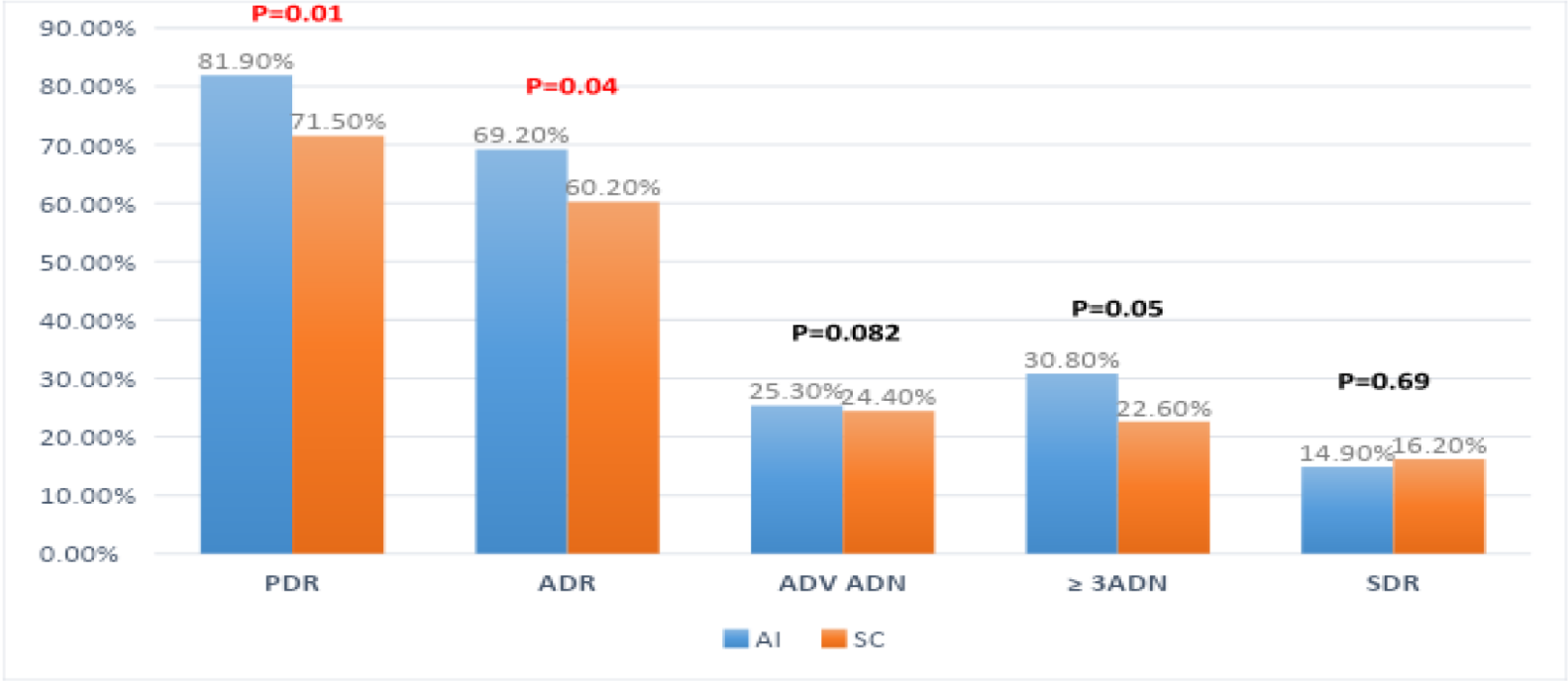
CADe increases ADR in FIT-based CCR program



Rondonotti E et al, Endoscopy 2022 [Epub]

Effective in increasing polyp detection

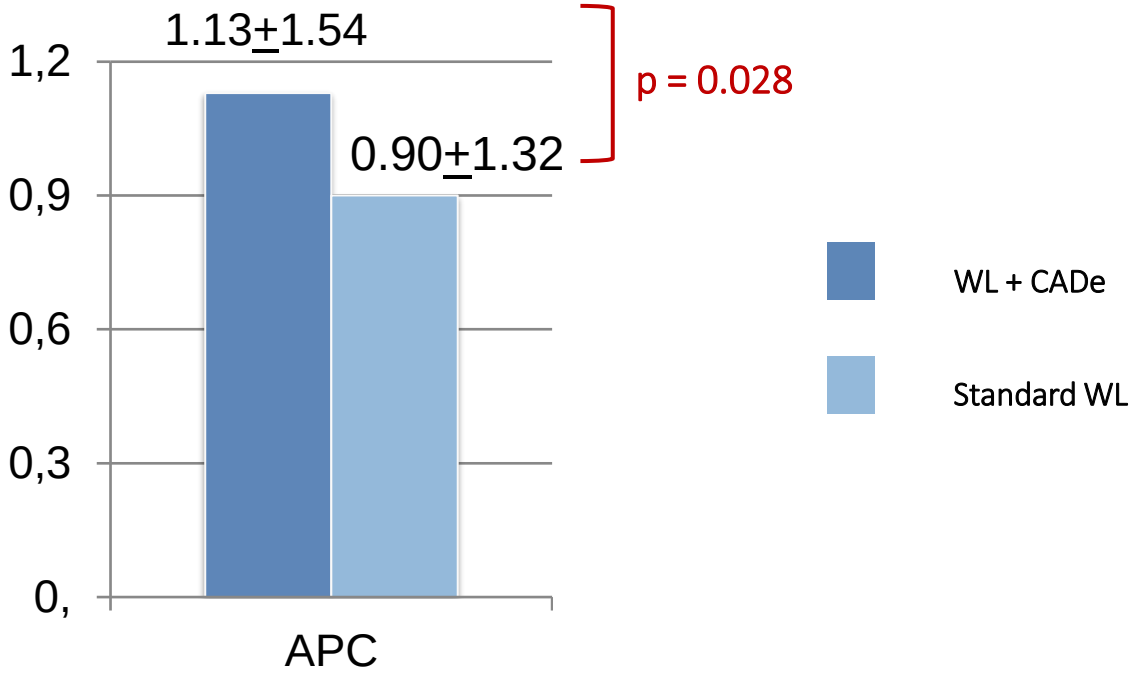
CADe increases ADR in FIT-based CCR program



atori EV at al, DDW 2022

Effective in increasing polyp detection

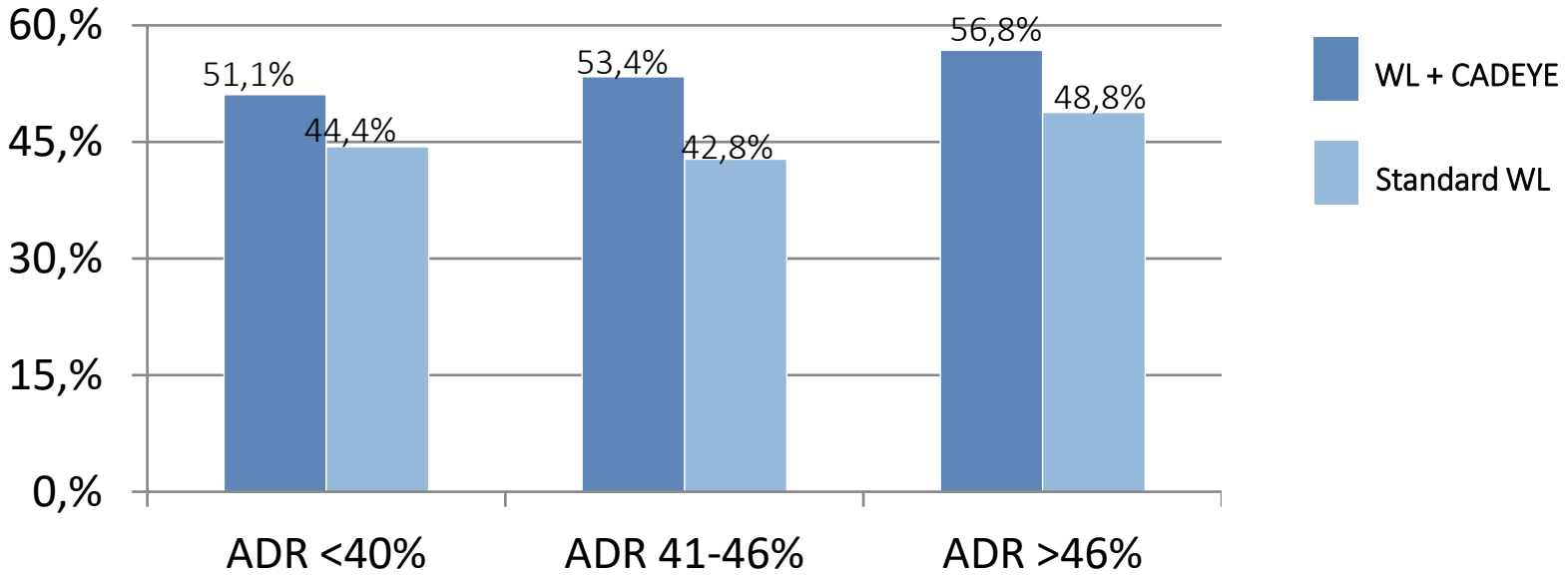
CADe increases APC in FIT-based CCR program



Rondonotti E et al, Endoscopy 2022 [Epub]

Effective in increasing polyp detection

CADe increases ADR in FIT-based CCR program: endoscopist expertise



Rondonotti E et al, Endoscopy 2022 [Epub]

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

Miguel Areia, Yuichi Mori*, Loredana Correale, Alessandro Repici, Michael Bretthauer, Prateek Sharma, Filipe Taveira, Marco Spadaccini, Giulio Antonelli, Alanna Ebigbo, Shin-ei Kudo, Julia Arribas, Ishita Barua, Michal F Kaminski, Helmut Messmann, Douglas K Rex, Mário Dinis-Ribeiro*, Cesare Hassan**

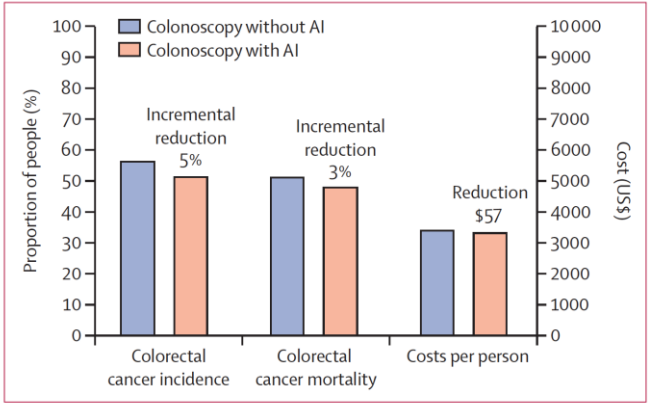


Figure 2: **Results of the primary health and cost analyses**
Expected risk of colorectal cancer incidence and mortality of colonoscopy screening with and without AI compared with non-screening. Estimated costs per person are also presented. AI=artificial intelligence.

	No screening	Colonoscopy without AI	Colonoscopy with AI
Colorectal cancer cases per year	148 204	84 463	77 268
Deaths from colorectal cancer per year	56 278	29 342	27 253
Colorectal cancer care cost per year, billion $	$10·90	$6·33	$5·79
Screening costs per year,* billion $	..	$5·13	$5·38
Total cost per year, billion $	$10·90	$11·46	$11·17

All costs are in US$. AI=artificial intelligence. *Including polypectomies, follow-up colonoscopies, and complications.

Table 2: **Projection on the US population of the superimposed screening strategies, assuming a 60% adherence to screening colonoscopy among individuals aged 50–100 years**

CADe study limitations:

- Diminutive polyps
- Unblinded
- “Hawthorne” effect
- Hype cycle curve (peak phase)
- Few expert centres
- Interval cancers? Mortality?

CADx

Real time optical diagnosis *(leave-in, R&D)*:

- Accuracy below recommended levels outside of expert centers
Rees C et al, Gut 2017; 66: 887-895

- Many barriers for implementation in routine practice

Willems P et al. Endosc Int Open 2020;8:E684-E692.

Real-Time Use of Artificial Intelligence in Identification of Diminutive Polyps During Colonoscopy

A Prospective Study

Yuichi Mori, MD, PhD; Shin-ei Kudo, MD, PhD; Masashi Misawa, MD, PhD; Yutaka Saito, MD, PhD; Hiroaki Ikematsu, MD, PhD; Kinichi Hotta, MD; Kazuo Ohtsuka, MD, PhD; Fumihiko Urushibara, MD, PhD; Shinichi Kataoka, MD; Yushi Ogawa, MD; Yasuharu Maeda, MD, PhD; Kenichi Takeda, MD, PhD; Hiroki Nakamura, MD; Katsuro Ichimasa, MD, PhD; Toyoki Kudo, MD, PhD; Takemasa Hayashi, MD, PhD; Kunihiko Wakamura, MD, PhD; Fumio Ishida, MD, PhD; Haruhiro Inoue, MD, PhD; Hayato Itoh, PhD; Masahiro Oda, PhD; and Kensaku Mori, PhD

Conclusion: Real-time CAD can achieve the performance level required for a diagnose-and-leave strategy for diminutive, non-neoplastic rectosigmoid polyps.

endocytoscopy + NBI or Methylen blue

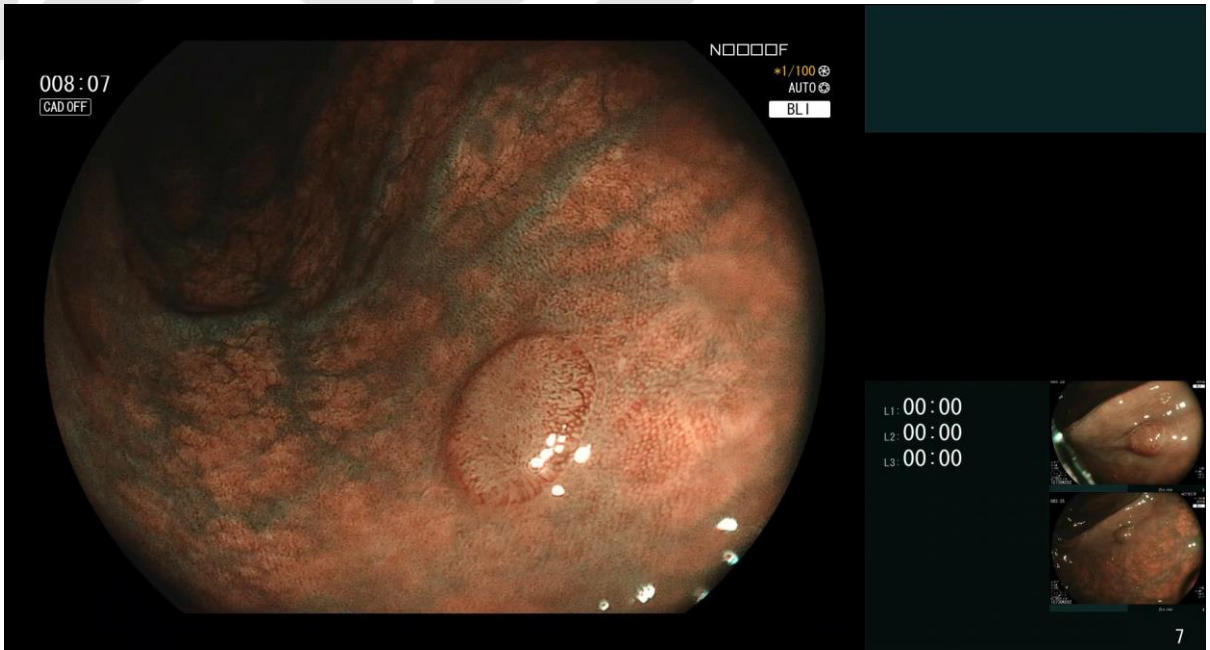
Endoscopy

Artificial intelligence assisted optical diagnosis for resect and discard strategy in clinical practice (Artificial intelligence BLI Characterization; ABC study)

Emanuele Rondonotti, Cesare Hassan, Giacomo Tamanini, Giulio Antonelli, Gianluca Andrisani, Giovanni Leonetti, Silvia Paggi, Arnaldo Amato, Giulia Scardino, Dhanai Di Paolo, Giovanna Mandelli, Nicoletta Lenoci, Natalia Terreni, Alida Andrealli, Roberta Maselli, Marco Spadaccini, Piera A Galtieri, Loredana Correale, Alessandro Repici, Francesco Maria Di Matteo, Luciana Ambrosiani, Emanuela Filippi, Prateek Sharma, Franco Radaelli.

Affiliations below.

DOI: 10.1055/a-1852-0330



Endoscopy

Artificial intelligence assisted optical diagnosis for resect and discard strategy in clinical practice (Artificial intelligence BLI Characterization; ABC study)

Emanuele Rondonotti, Cesare Hassan, Giacomo Tamanini, Giulio Antonelli, Gianluca Andrisani, Giovanni Leonetti, Silvia Paggi, Arnaldo Amato, Giulia Scardino, Dhanai Di Paolo, Giovanna Mandelli, Nicoletta Lenoci, Natalia Terreni, Alida Andrealli, Roberta Maselli, Marco Spadaccini, Piera A Galtieri, Loredana Correale, Alessandro Repici, Francesco Maria Di Matteo, Luciana Ambrosiani, Emanuela Filippi, Prateek Sharma, Franco Radaelli.

Affiliations below.

DOI: 10.1055/a-1852-0330

- 4 Centers
- 18 endoscopists: (9 experts)
- 596 diminutive RectoSigmoid Polyps (DRSPs)
- NPV DRSPs ≥90% for Endoscopist+AI

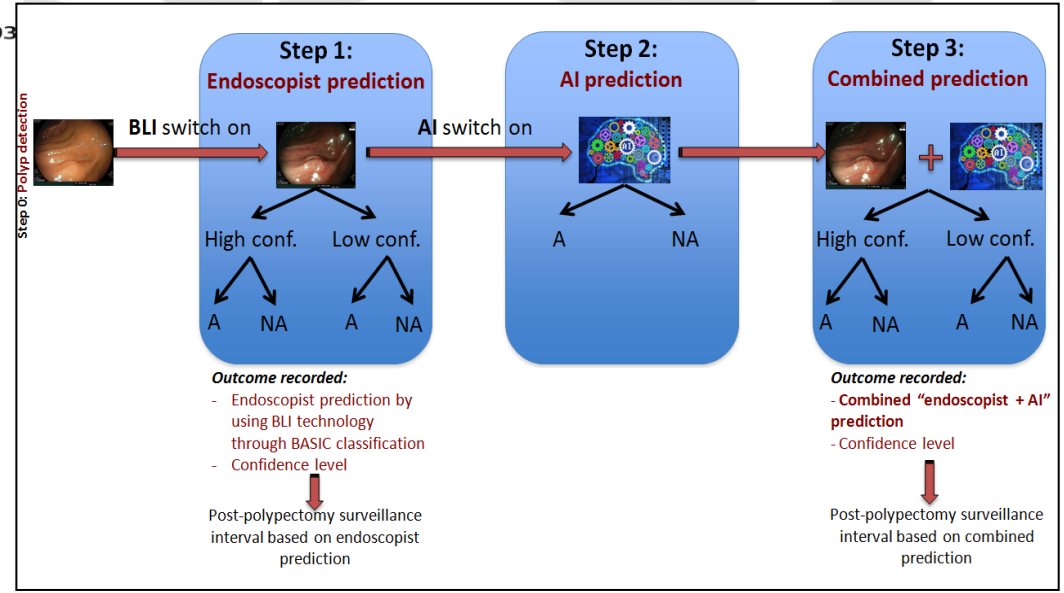
Endoscopy

Artificial intelligence assisted optical diagnosis for resect and discard strategy in clinical practice (Artificial intelligence BLI Characterization; ABC study)

Emanuele Rondonotti, Cesare Hassan, Giacomo Tamanini, Giulio Antonelli, Gianluca Andrisani, Giovanni Leonetti, Silvia Paggi, Arnaldo Amato, Giulia Scardino, Dhanai Di Paolo, Giovanna Mandelli, Nicoletta Lenoci, Natalia Terreni, Alida Andrealli, Roberta Maselli, Marco Spadaccini, Piera A Galtieri, Loredana Correale, Alessandro Repici, Francesco Maria Di Matteo, Luciana Ambrosiani, Emanuela Filippi, Prateek Sharma, Franco Radaelli.

Affiliations below.

DOI: 10.1055/a-1852-03



CADx for polyp characterization

CADx technical feasibility and combined high-confidence rate

CADx «technical» feasibility:

→ 541/596: **90.8%** (95%CI [88.2-92.9]%)

CADx for polyp characterization

CADx technical feasibility and combined high-confidence rate

CADx «technical» feasibility:

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- → Unstable characterization: 7.9%
- → Impossible characterization: 1.3%

CADx for polyp characterization

CADx technical feasibility and combined high-confidence rate

CADx «technical» feasibility:

→ 541/596: **90.8%** (95%CI [88.2-92.9]%)

- → Unstable characterization: 7.9%
- → Impossible characterization: 1.3%

Combined CADx-endoscopist high confidence rate:

	Endoscopist+AI
Number of DRSPs evaluated	550/596
High-confidence rate	92.3%

CADx for polyp characterization

Clinical performances

Accuracy parameter	Endoscopist+AI (95% CI)
Sensitivity	88.6% (83.7-91.4)
Specificity	88.1% (83.9-91.4)
Positive predictive value	85.1% (79.8-89.1)
Negative predictive value	91.0% (87.1-93.9)
Accuracy	88.4% (85.3-90.9)

Rondonotti E et al, Endoscopy 2022 [Epub]

CADx for polyp characterization

Clinical performances

Accuracy parameter	Endoscopist+AI (95% CI)	Endoscopist (95%CI)
Sensitivity	88.6% (83.7-91.4)	88.6% (83.6-92.2)
Specificity	88.1% (83.9-91.4)	88.8% (84.5-91.9)
Positive predictive value	85.1% (79.8-89.1)	86.1% (80.8-90.0)
Negative predictive value	91.0% (87.1-93.9)	90.9% (86.8-93.7)
Accuracy	88.4% (85.3-90.9)	88.7% (85.7-91.2)

p= ns

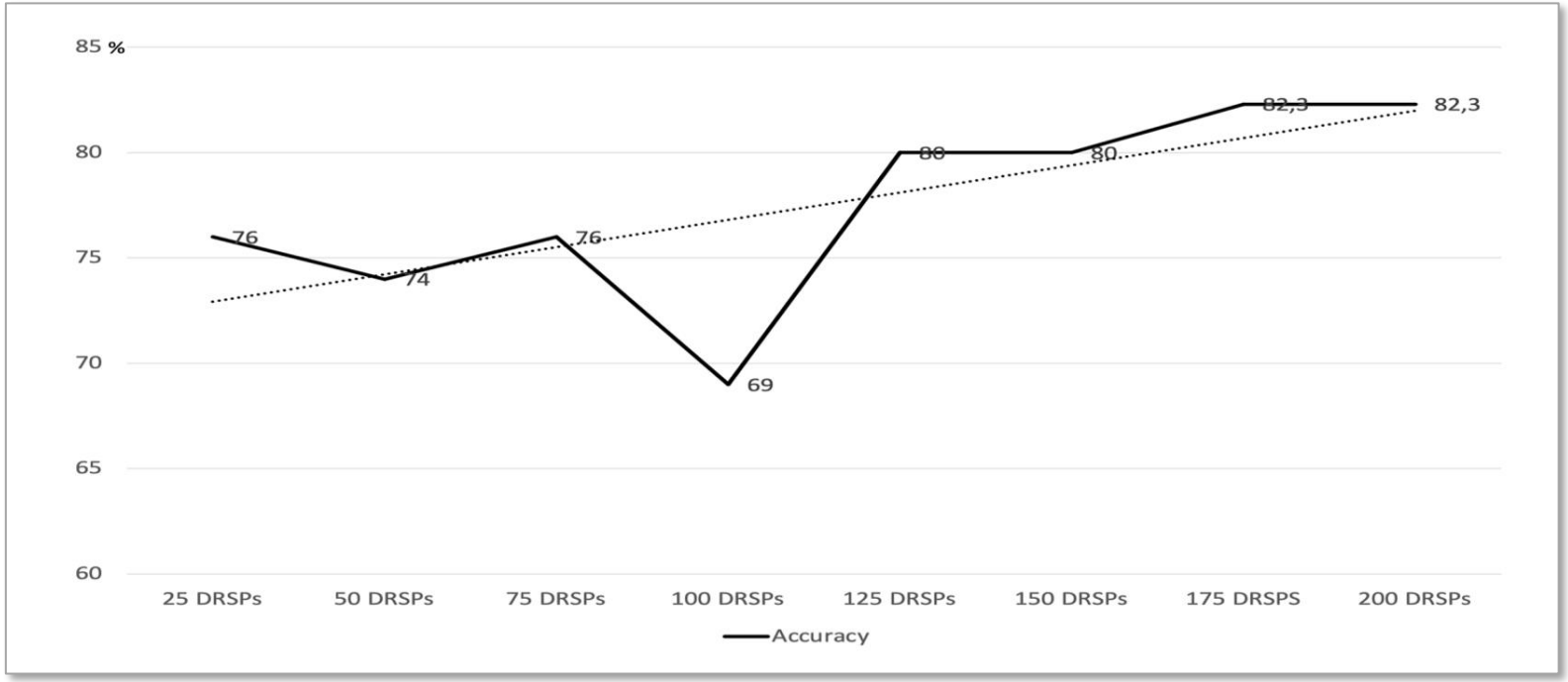
Rondonotti E et al, Endoscopy 2022 [Epub]

Table 3. Performance of Standard and AI-Derived CADx Optical Diagnosis of Small Rectosigmoid Polyps during Colonoscopy Compared with Histopathology.*

Parameter	Standard Diagnosis	CADx Diagnosis
Sensitivity	88.4 (84.3 to 91.5)	90.4 (86.8 to 93.1)
Specificity	83.1 (79.2 to 86.4)	85.9 (82.3 to 88.8)
Positive predictive value	78.9 (74.3 to 82.9)	82.0 (77.6 to 85.6)
Negative predictive value	91.5 (88.5 to 93.8)	92.8 (90.1 to 94.9)
High confidence in optical diagnosis	74.2 (70.9 to 77.3)	92.6 (90.6 to 94.3)

Barua I et al, NEJM Evidence [Epub]

CADx for non-experts

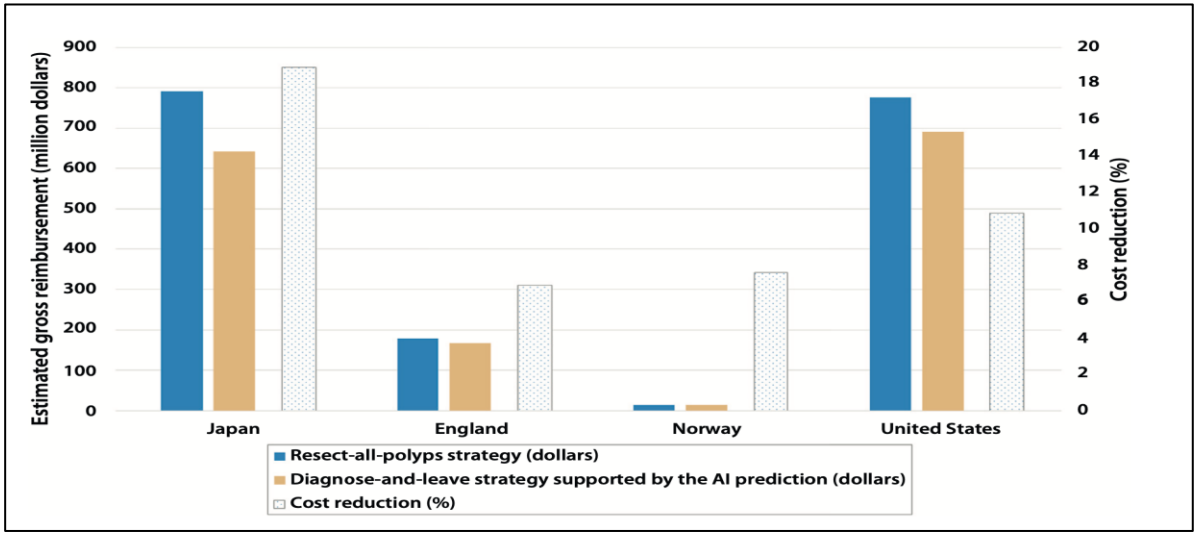


Rondonotti E et al. Submitted to Endoscopy

Cost savings in colonoscopy with artificial intelligence-aided polyp diagnosis: an add-on analysis of a clinical trial (with video)*

Yuichi Mori, MD, PhD,[1] Shin-ei Kudo, MD, PhD,[2] James E. East, MD,[3,4] Amit Rastogi, MD,[5] Michael Bretthauer, MD, PhD,[1,6] Masashi Misawa, MD, PhD,[1] Masau Sekiguchi, MD, PhD,[7,8,9] Takahisa Matsuda, MD, PhD,[7,8,9] Yutaka Saito, MD, PhD,[9] Hiroaki Ikematsu, MD, PhD,[10] Kinichi Hotta, MD,[11] Kazuo Ohtsuka, MD, PhD,[12] Toyoki Kudo, MD, PhD,[1] Kensaku Mori, PhD[13]

Yokohama, Tokyo, Kashiwa, Shizuoka, Nagoya, Japan; Oxford, United Kingdom; Kansas City, Kansas, USA; Oslo, Norway



CADe study limitations:

- Experienced endoscopists
- Suboptimal results (AI alone)
- Polyps always resected
- Interaction human being/AI

What we know:

- Early integration of AI represent a reasonable measure of quality assurance for all the stakeholders involved in screening programs
- AI-assisted optical characterization is promising and might boost the implementation of *leave-in* and *R&D strategy* in clinical practice
- More clinical data are needed
- AI cannot substitute endoscopist
- AI does not offset the need for a high-level of expertise and training (characterization!)

Expectations:

- Clinical testing of new AI features (CIR calculation, quality of bowel prep, polyp sizing etc…)
- CADe: AI + mucosal exposure devices
- CADx: 2nd generation CADx systems (continuous improvement!)


AI is Here to Stay
Here is Why You Should Not be Afraid