Impatto dell’intelligenza artificiale nell’utilizzo della videocapsula

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EUROPEAN ENDOSCOPY TRAINING CENTER

- ✓ A typical small bowel CE study collects around 50’000-60’000 images
- ✓ Time of reading is around 30-120 minutes according to reader’s experience
- ✓ Pathological findings may be present in one or few more images

CE Reading

Time Consuming

Risk of Oversight

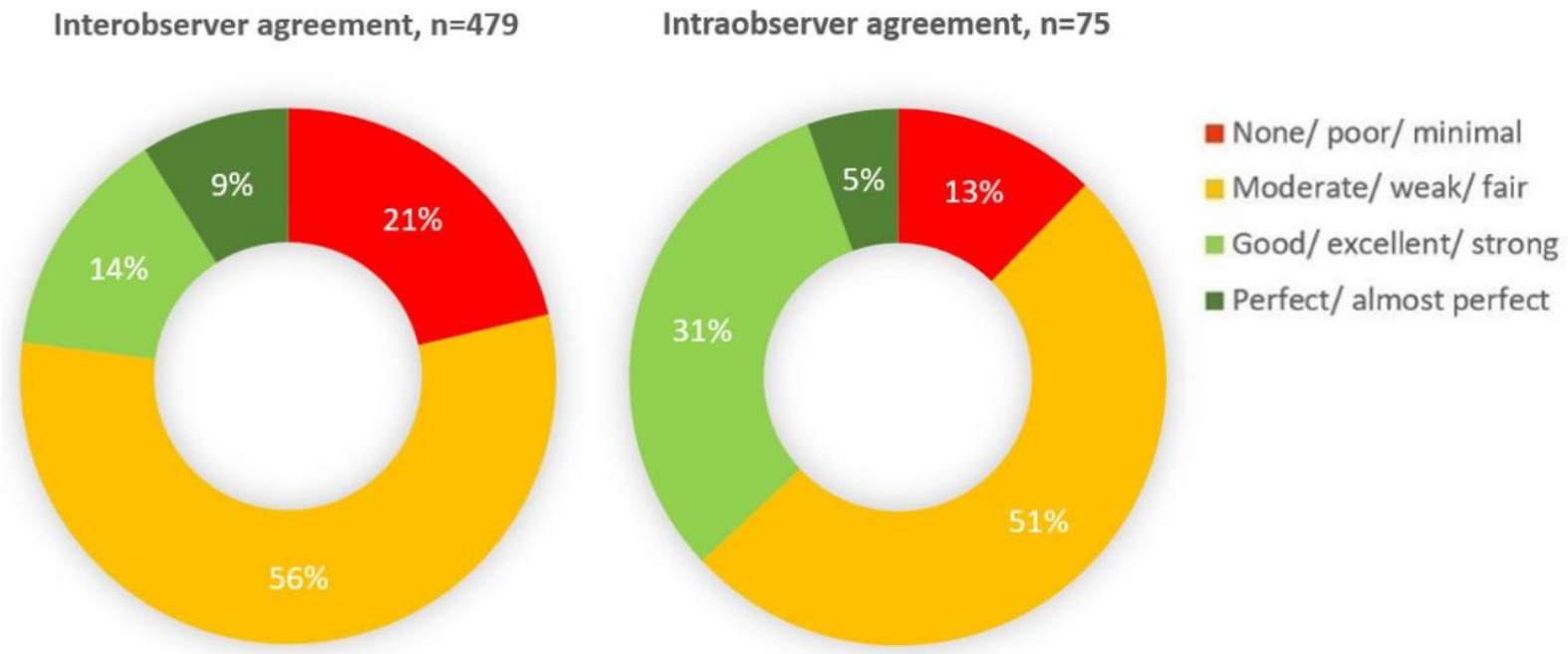
Fatigue of the endoscopist

Cost

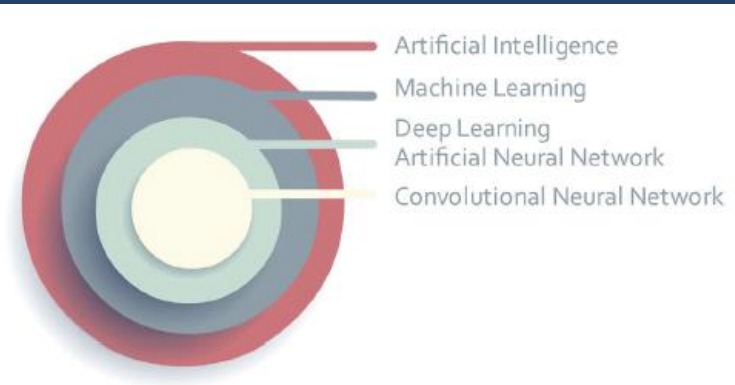
SB Capsule Endoscopy

reading ⟷ quality

SB Capsule Endoscopy



Pablo Cortegoso Valdivia. Diagnostics 2022

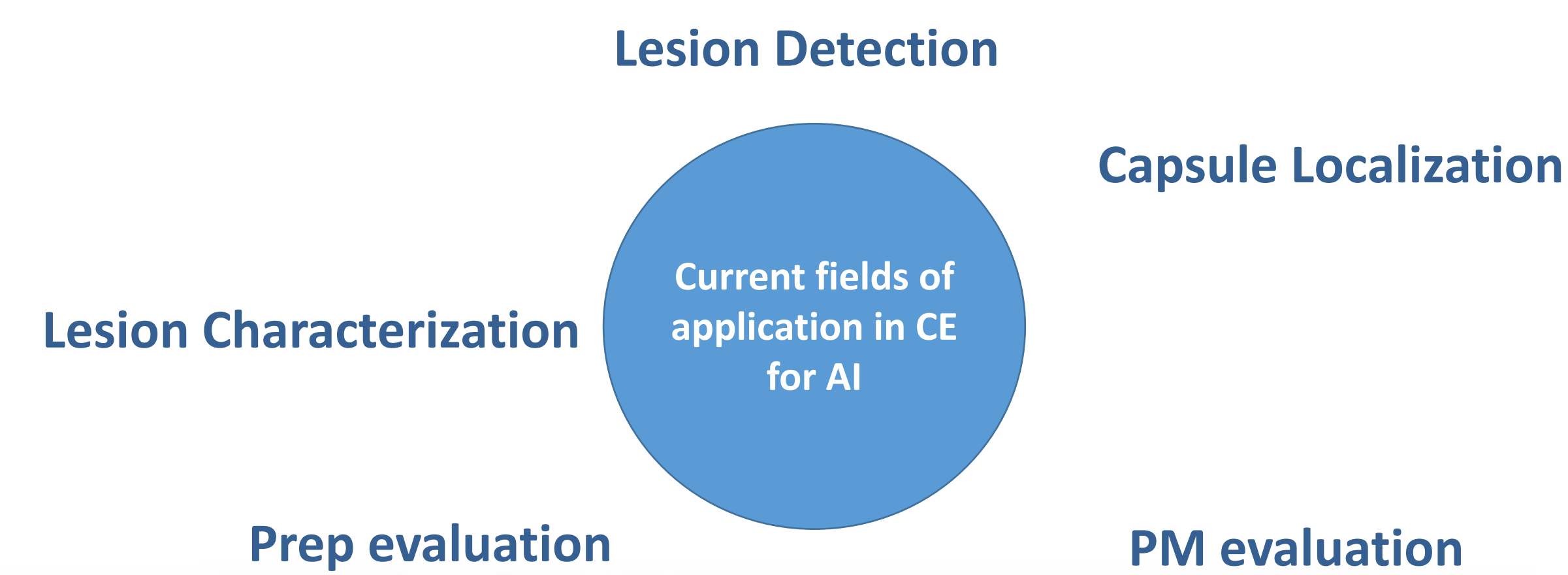


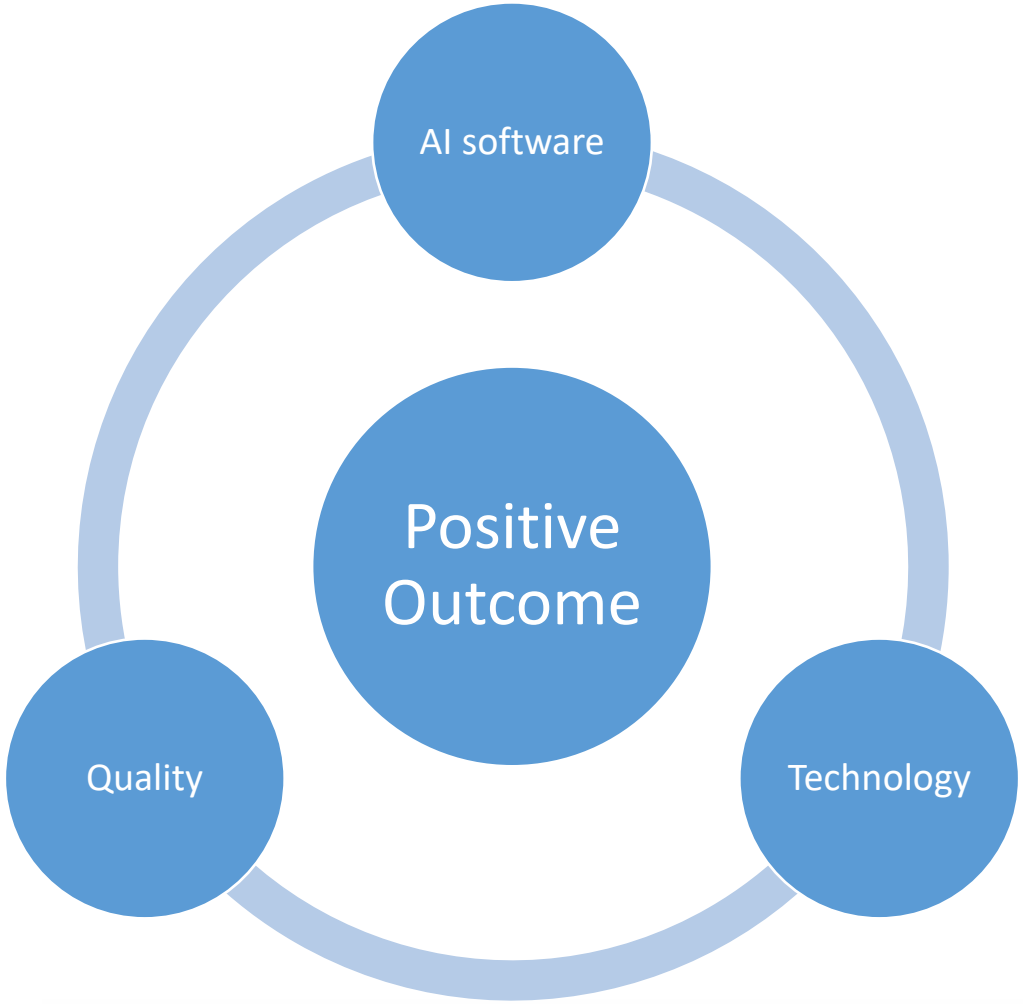
Impact of AI on CE

- Quick View
- SBI indicator
- TOP 100 Selection
- Omni Mode Express View
- Support Vector Machines
- Convolutional Neural Networks

2009 — **2019**

Impact of AI on Capsule Endoscopy




AI software
Positive Outcome
Quality
Technology

Available technology

	Field of view	Lens	Leds	Image sensor	Transmission	Battery life	Frame/sec	Dimension
PillCam SB3	156	Multielements	4	CMOS	Radiofrequency	9-11,5	AFR(2-6)	11 x 26
MiroCam v2	170	NA	4	CMOS	EFP*	12	3	11 x 24
EndoCapsule	145	NA	4	CCD	Radiofrequency	10	2	11 x 26
OMOM HD	172	Multielements	4	CCD	Radiofrequency	12	AFR (2-10)	11 x 25.4
CapsoCam SV1	360	NA	16	NA	On-board	15	16 (4 per camera)	11 x 31
PillCam Colon 2	172x2	Multielements	4	CMOS	Radiofrequency	10	AFR(4-35)	11 x 31
PillCam Crohn	172x2	Multielements	4	CMOS	Radiofrequency	10	AFR(4-35)	11 x 31
NaviCam	140	Multielements	4	CMOS	Radiofrequency	12	AFR(0.5-12)	11.8 x 27

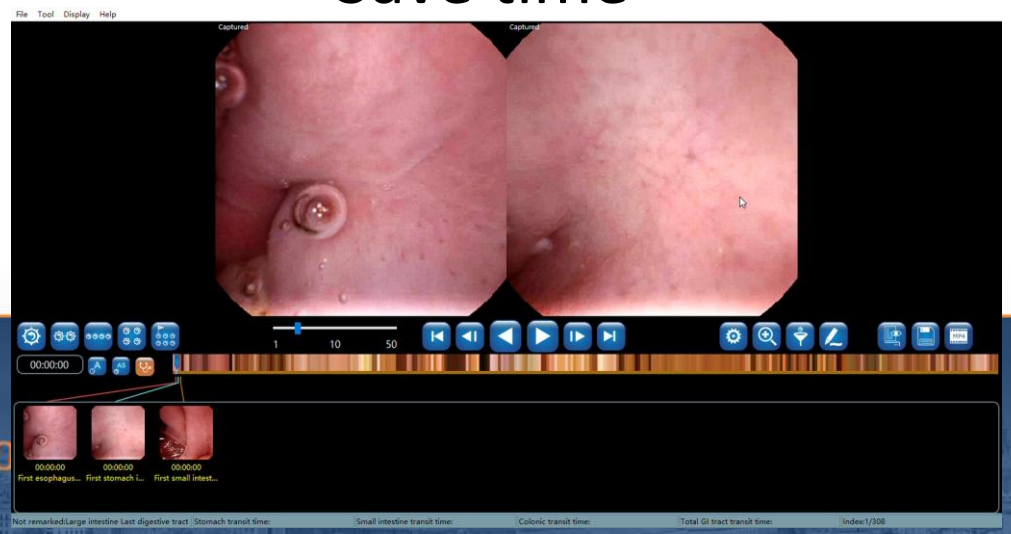
* Electric Field Propagation

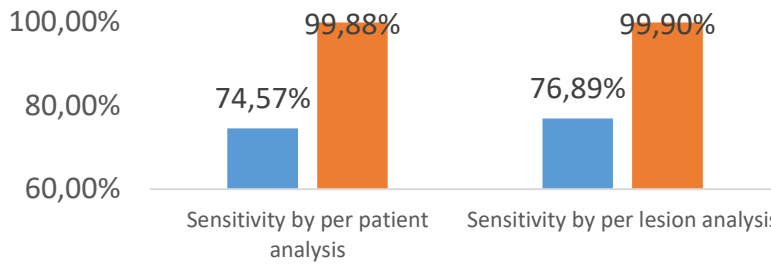
Navicam ProScan system (Ankon Tech)

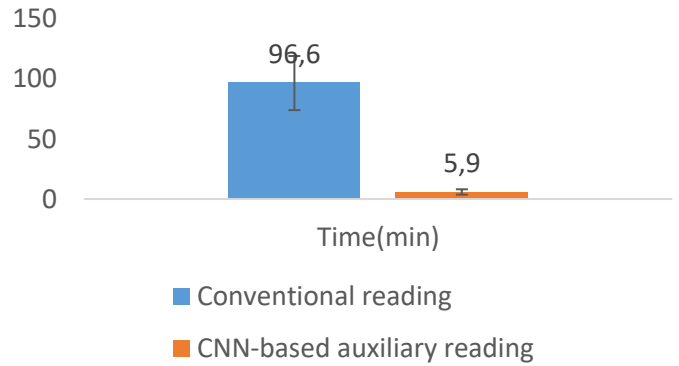
Thousands of Images

AI Engine by ANKON

Save time







Ding Z. Gastroenterology 2019

- **Design Goal:**
  - High **sensitivity** to screen out as many lesions as possible, and
  - High **efficiency** to reduce the long and tedious capsule video reading time – one of the main obstacles hold SB capsule application

- **Data Sources:**
  - 113,426,569 images from 6970 videos of 6970 patients who had SB capsule procedures at 77 medical centers from 2016 to 2018
    - 1970 videos for training (158.235 SB/CE images)
    - 5000 videos for validation

AI-assisted capsule endoscopy reading in suspected small bowel bleeding: a multicentre prospective study

ArtIC Study

ARTificial Intelligence Capsule endoscopy study

Cristiano Spada, Stefania Piccirelli*, Cesare Hassan, Clarissa Ferrari, Ervin Toth, Begoña González-Suárez, Martin Keuchel, Marc McAlindon, Ádám Finta, András Rosztóczy, Xavier Dray, Daniele Salvi, Maria Elena Riccioni, Robert Benamouzig, Amit Chattree, Adam Humphries, Jean-Christophe Saurin, Edward J Despott, Alberto Murino, Gabriele Wurm Johansson, Antonio Giordano, Peter Baltes, Reena Sidhu, Milan Szalai, Krisztina Helle, Artur Nemeth, Tanja Nowak, Rong Lin, Guido Costamagna*

www.thelancet.com/digital-health **Vol 6 May 2024**

- Multicenter, blinded, prospective, non-inferiority study (AI vs conv reading) in suspected small bowel bleeding
- Consecutive, comparative series of patients
- Primarily: to assess non-inferiority of AI-assisted vs conv reading in the detection of SB lesions* in a per-patient analysisin a **real-world setting**, using entire, **unaltered** small bowel capsule endoscopy videos
- Secondarily: accuracy of readers and mean reading time in AI-assisted vs conventional reading

ArtIC Study – Results (1)

133 pts included in the final analysis (F=73, mean age 66.49 yrs ± 14.4)

Completion rate: 84.2%; Adequate SB Cleansing: 70% of pts

Out of 133 patients:

- Readers in SM identified P1+P2 lesions in **83** pts

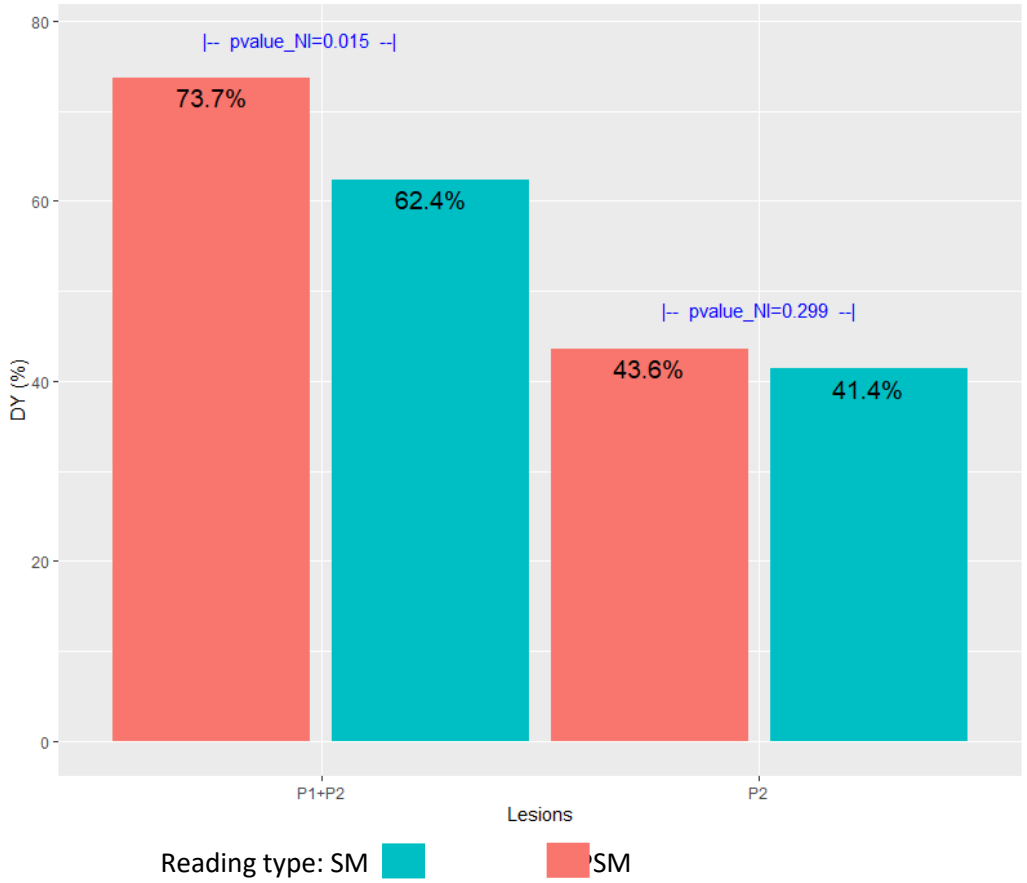
(P2 lesions: n=55 pts; P1 lesions: n=28 pts)

- Readers in PSM identified P1+P2 lesions in **98** pts

(P2 lesions: n=58 pts; P1 lesions: n=40 pts)

- The Board identified P1+P2 lesions in **105** pts

(P2 lesions: n=65 pts; P1 lesions: n=40 pts)



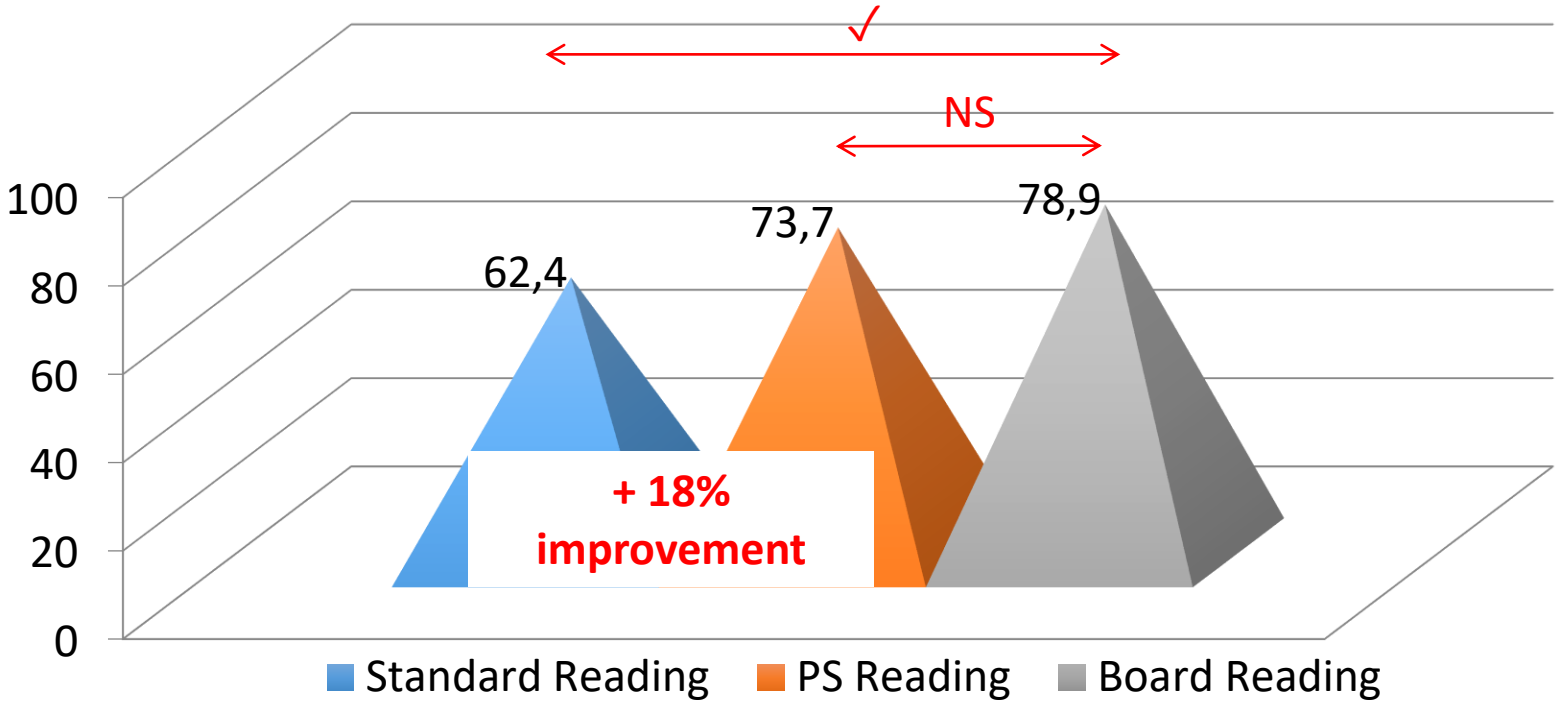
PSM vs SM	Per-patient analysis (DY)	
	P1+P2 lesions	«P2 only» lesions
Non inferiority	**X** **p = 0.015**	- p = 0.299
Superiority	**X** **p = 0.035**	- p = 0.422

Primary aim

%, 95 CI	*P2+P1 lesions*			*P2 lesions*		
	SM	PSM	P value	SM	PSM	P value
Sensitivity	79.0	93.3	**0.005**	84.6	89.2	0.603
Specificity	100.0	100.0	1	100.0	100.0	1
PPV	100.0	100.0	1	100.0	100.0	1
NPV	56.0	80.0	**0.039**	87.2	90.7	0.668
Diagnostic accuracy	83.5	94.7	**0.006**	92.5	94.7	0.616

Spada C. Lancet Digit Health. 2024

ArtIC Study – Results (Diagnostic Yield)



Diagnostic Yield (P1+P2) (%)

	Difference (%)	CI	
DY SR vs board	16.5	(95%CI: 5-28%)	✓
DY PS vs board	5.7	(95%CI: -16.2-5.7%)	NS

Spada C. Lancet Digit Health. 2024


ankon
ankon

=

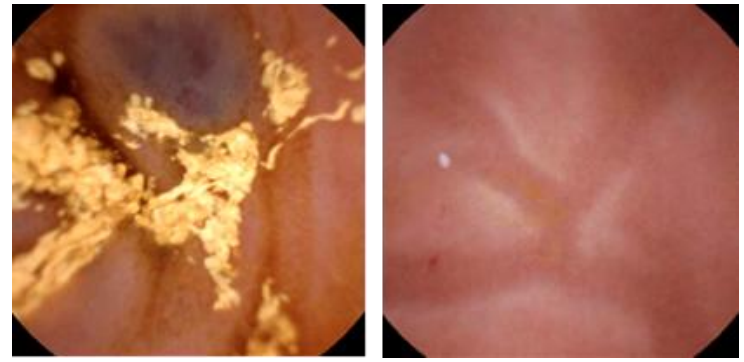
ArtIC Study – Results

Secondary aims

ProScan sensitivity was 100% at per-patient analysis

At per-lesion analysis, ProScan missed a P2 lesion and a P1 lesion

→ Sensitivity:
- → 99.5% for P1+P2 lesions (n=362/364)
- → 99.2% for “P2” lesions (n=122/123)



	Standard Reading	AI-assisted reading	p value
Mean Reading time +/- SD Small Bowel	00:33:42 ± 00:22:51	00:03:50 ± 00:03:20	< 0.001
Mean Reading time+/- SD All GI tract	00:43:32 ± 00:25:52	00:06:00 ± 00:04:41	< 0.001
Mean images/video	27504	1366	< 0.001

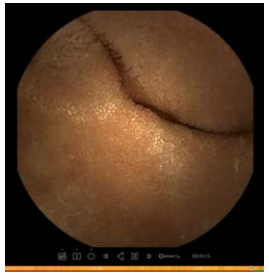
CE reading 9.54x

20x

Spada C. Lancet Digit Health. 2024

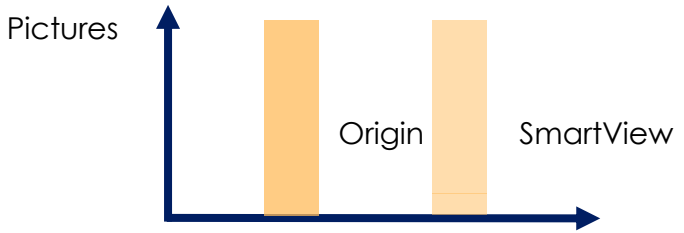
OMOM system: SmartScan_Redundancy Deletion

- High resolution images
- A.I. software for effective lesions identification



Up to

90% Less



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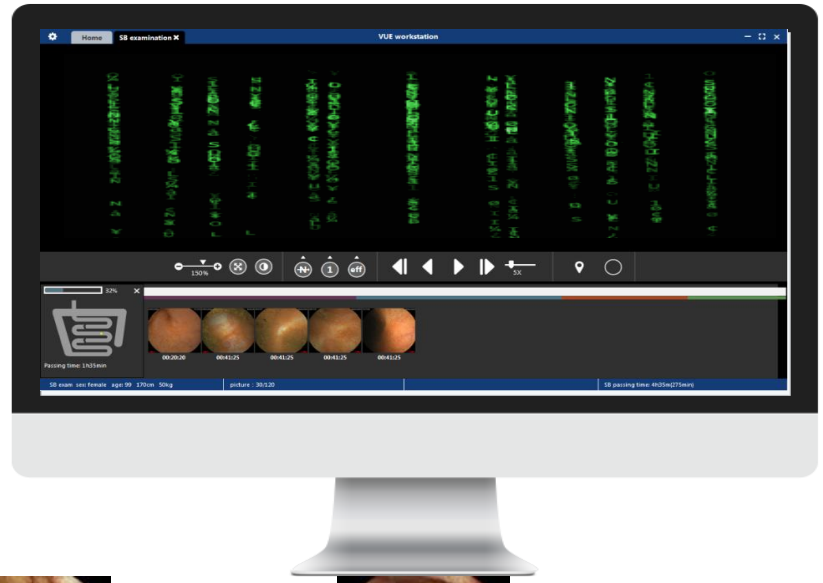
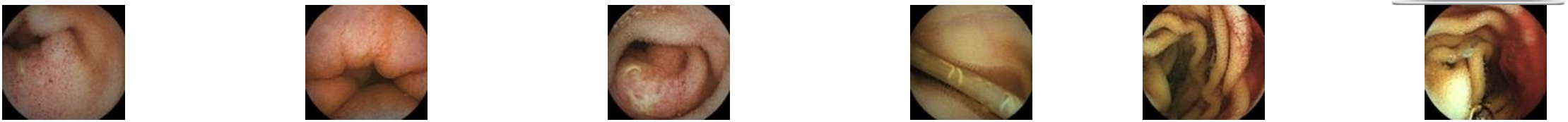
SmartScan_Abnormality Detection

as many as 16 types of abnormalities

Bleeding 4%





Development and Validation of an Artificial Intelligence Model for Small Bowel Capsule Endoscopy Video Review

- Multicenter, retrospective diagnostic study
- Deep learning neural network used : SmartScan (OMOM Capsule Endoscopy System)
  - Training set: 2927 SBCE examinations from 29 medical centers 17 types of CE structured terminology –CEST
  - Validation set: 2898 SBCE examinations collected from 22 medical centers
- Aim: develop an AI diagnostic model for the automatic diagnosis of 17 types of findings and to test its diagnostic performance

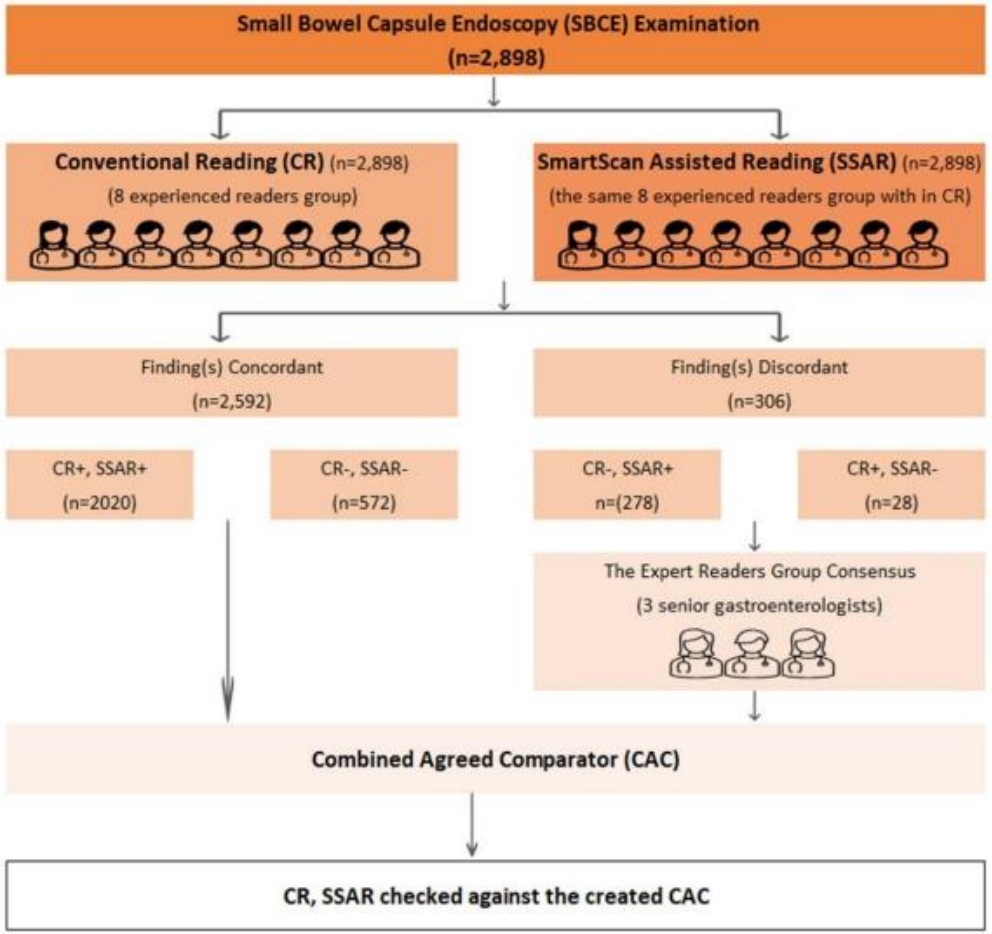


Table 1. Overall Detection of Findings by Conventional Reading and SmartScan-Assisted Reading

Characteristic	No.	Conventional reading	SmartScan-assisted reading	*P* value	Combined agreed comparator
Patients, No. (%)					
With findings	2898	2048 (70.7)	2298 (79.3)	<.001	2326 (80.3)
Without findings		850 (29.3)	600 (20.7)		572 (19.7)
Small bowel capsule endoscopy findings, No. (%)	6084	4630 (76.1)	5834 (95.9)	<.001	6084 (100.00)

Xie et al. JAMA Network Open. 2022;5(7):e2221992.

Development and Validation of an Artificial Intelligence Model for Small Bowel Capsule Endoscopy Video Review

eTable 6. Reading Time and Number of Images by Conventional Reading (CR) and *SmartScan* Assisted Reading (SSAR)

		CR	SSAR	P value	Difference between two readings
SBCE Reading time (min)	Mean (SD)	51.42(11.60)	5.37(1.51)		46.05(11.16)
	Med (IQR)	50 (43-58)	5 (4-6)	<0.001 [a]	45 (38-53)
	Med (range)	50 (30-130)	5 (3-12)		45 (25-123)
Number of SBCE Images	Mean (SD)	27,910.83(12,882.89)	779.17(337.18)		27,131.66(12,888.95)
	Med (IQR)	26,277 (19,218-35,673)	861 (502-1,044)	<0.001 [b]	25,495 (18,398-34,905)
	Med (range)	26,277 (860.0-81,907)	861 (101-1,554)		25,495 (350-81,789)

a Comparison of reading time between CR and SSAR, non-parametric paired Wilcoxon rank sum test： Z=46.629，P<0.001

b Comparison of the number of pictures between CR and SSAR, non-parametric paired Wilcoxon rank sum test： Z=46.625, P<0.001

Xie et al. JAMA Network Open. 2022;5(7):e2221992.

Multicentre prospective study on the diagnostic performance of MiroCam MC2000 double tip small bowel capsule AI scan, first real-world study on all indications.

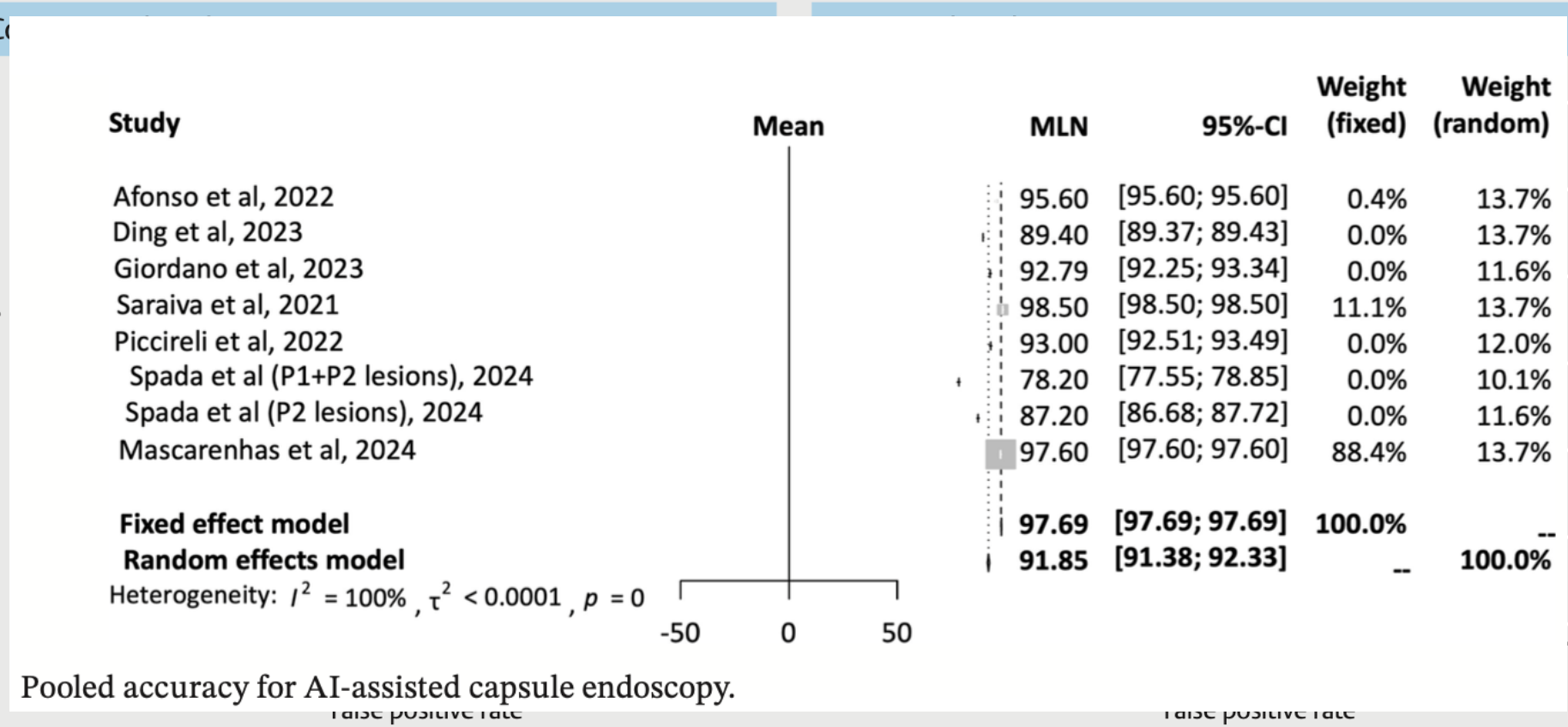
@ ESGE 2025

MC2000

259,200 images

242 pts (SSBB, CD, IDA)

	Standard reading	AI reading	
Sensitivity	96.5% (CI 91.2-99%)	95.3% (CI 90.1-98.3%)	NS
Specificity	85.3% (CI 78-90.9%)	96.5% (CI 91.3-99%)	NS
Positive Findings	82.2%	86%	p<0.04
Mean reading time	38.2 (SD 20.96)	18.26 (SD 10.79)	p<0.01

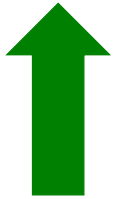


Pooled accuracy for AI-assisted capsule endoscopy.

Pablo Cortegoso Valdivia. LIO 2025 Dhali A. JGH 2025

Efficacy

Detection



Efficiency

Reading Time

Limitations of available evidence

- Very high levels of heterogeneity
- Specificity:
  - false positives
  - risk of unnecessary follow-up investigations
  - patient anxiety
  - increased workload
- Performance of junior readers? (any potential role as booster?)

31° CONGRESSO NAZIONALE DELLE MALATTIE DIGESTIVE
13 - 15 APRILE 2025
ERGIFE PALACE HOTEL, ROMA

fismad
federazione italiana società malattie apparato digerente

DIAGNOSTIC YIELD OF AI-ASSISTED CAPSULE ENDOSCOPY: A COMPARISON BETWEEN EXPERTS AND TRAINEES IN AN 80-CASE SERIES

Tettoni E.[1], Piccirelli S.[1], Ferrari C.[1], Salvi D.[1], Pesatori E.V.[1], Belluardo N.[1], Marmo C.[2], Cesaro P.[1], Spada C.[2]

1. Fondazione Poliambulanza Istituto Ospedaliero, Brescia

2. Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Roma

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AI-assisted reading by trainees vs standard reading by expert

	TRAINEES AI (n = 453)	EXPERT SR (n = 198)
TP	288 (63,4%)	129 (64,9%)
TN	30 (6,6%)	29 (9,5%)
FP	78 (17,2%)	6 (3,0%)
FN	58 (12,8%)	45 (22,6%)

Critical Equation to Remember!!!

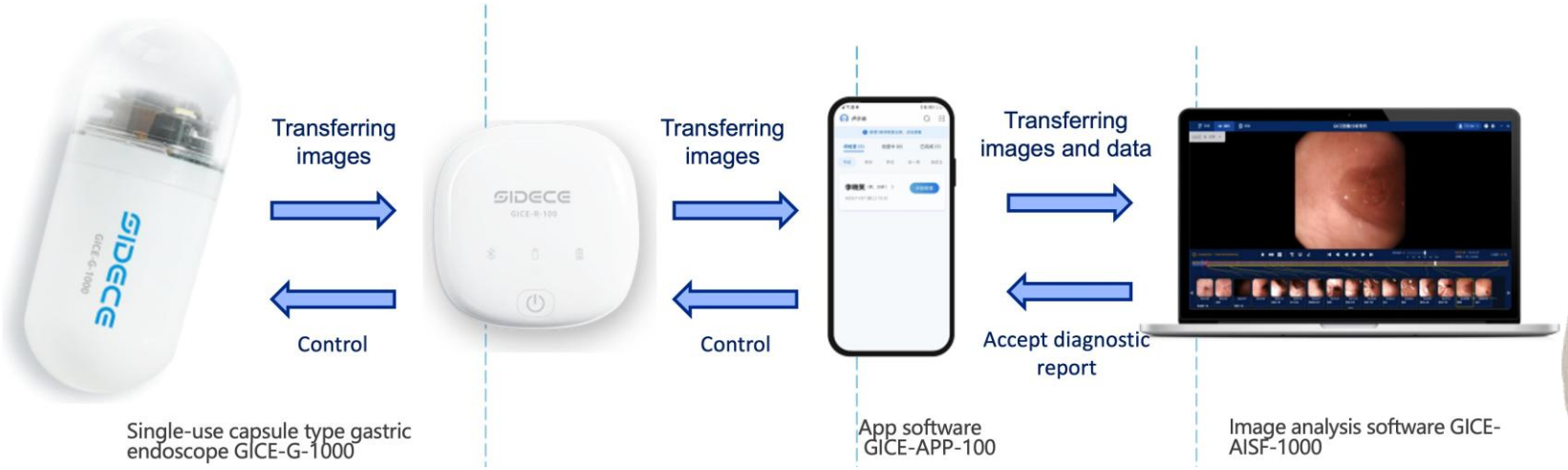
NT + OO = COO

New Technology Old Organization Costly Old Organization

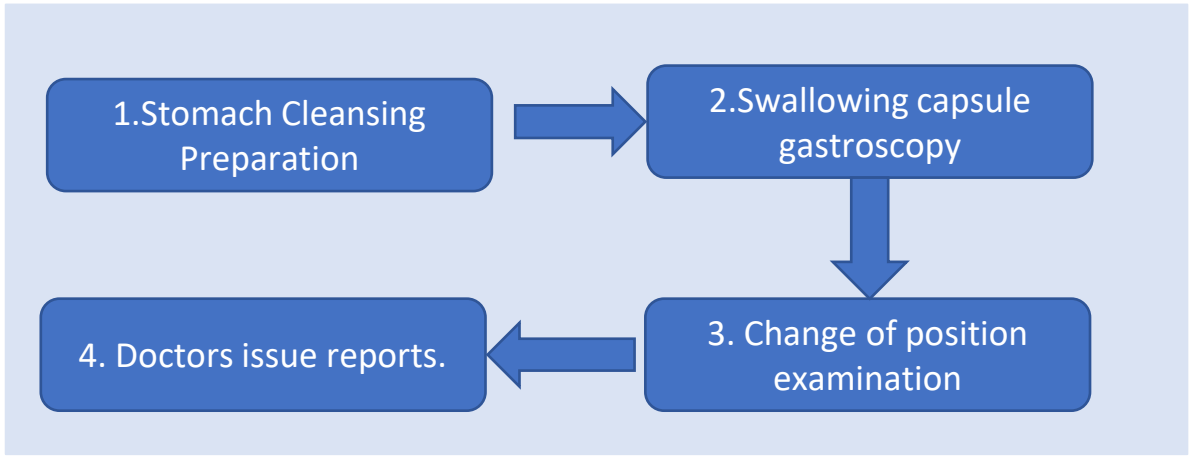
Side intelligent Medical mobile phone Gastroscope

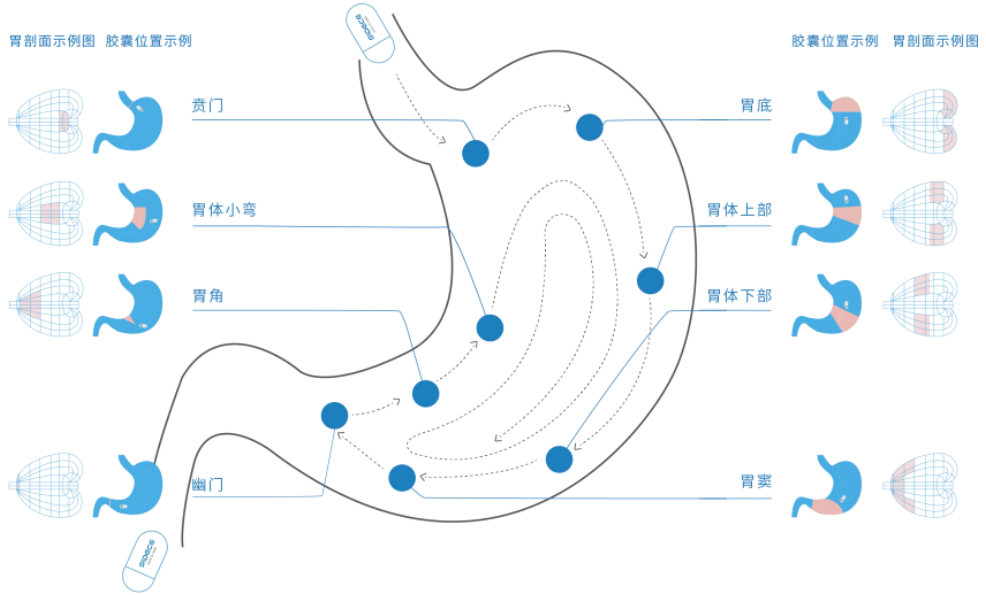
(GICE-1000 Capsule Gastric Endoscopy System)

- Mobile capsule gastroscopy
  - Single-use capsule endoscope
  - Portable recorder (no wearable device)
  - App software (to guide through simple changes in posture)
  - Image analysis software

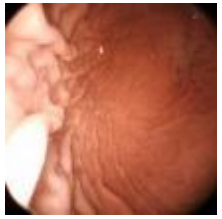


Stomach scanning






cardia

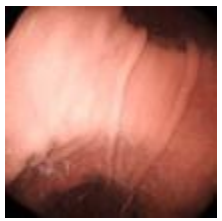

Gastric fundus


Upper part of gastric body


Lower part of gastric body


Gastric antrum


Gastric angle


Lesser curvature


pylorus

康华云镜专科门诊部

GICE胶囊内窥镜诊断报告

科室：消化内科（内镜室）　姓名：Cristiano Spada　检查编号：1811235614327521281

姓名： Cristiano Spada	性别：男	年龄： 54
检查编号： 1811235614327521281	胶囊编号： G0240310000845	检查项目：胃
检查日期： 2024-07-12	报告日期： 2024-07-12	阅片医生：洪思蔚

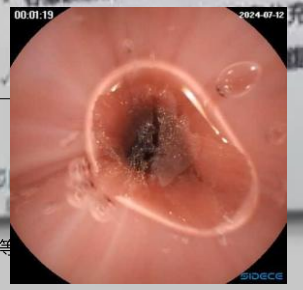
胶囊通过时间：
全部：0h 27m 26s 食管 0h 0m 5s，胃 0h 26m 2s。

检查所见：
食管：清洁度良，见少许泡沫干扰，舒缩可，镜检范围内所见黏膜光滑，未见明显糜烂、溃疡、肿物等
贲门：清洁度良，贲门内口未见息肉、糜烂等；
胃底：清洁度良，充盈度良，镜检范围内黏膜光滑，未见明显肿物、溃疡、静脉曲张；
胃体：清洁度中，见黏液干扰，充盈度良，镜检范围内黏膜光滑，胃体中部皱襞粗大均匀，蠕动可，
样隆起，山田分型，I型或II型，丘状或半球形，色白，直径约3-5mm（大小仅供参考），胃体下部大
，小弯见一小片状黏膜发红，未见明显溃疡、肿物等；
胃窦：清洁度良，充盈度良，镜检范围内黏膜轻度水肿，见一片状平坦糜烂灶，未见明显溃疡、肿物等
胃角：弧形，光滑，未见肿物及溃疡；
幽门：圆形，开闭好。

检查结果：
1.慢性浅表性胃炎
2.胃多发息肉

综合建议：
1.胃部轻度炎症表现，可能与幽门螺旋杆菌感染/经常性酒精刺激/进食作息紊乱/长期胆汁反流/特殊药
相关，具体需结合临床，注意避免生冷辛辣刺激食物，少吃甜食，规律作息，定期复查。
2.胃多发息肉，建议可择期内镜下治疗或定期复查，请结合临床。

典型结构图片：



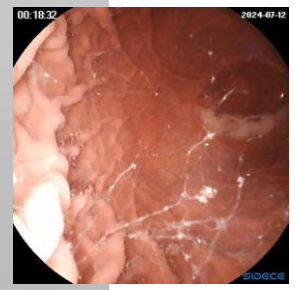
食管

食管

贲门内口

贲门内口,胃体上部

胃底



胃底,胃体上部

胃底体交界

胃体上部

胃体下部

报告医生：

Stomach scanning

Provide an exclusive position change plan with high coverage, and the examinee can complete the examination under the guidance of a doctor/nurse and guided by their mobile mobile phone position.

Coverage rate of gastric anatomical site	
Cardia	99.4%
gastric fundus	99.4%
gastric body	100%
Stomach angle	100%
gastric antrum	100%
pylorus	100%

Inclusion of cases: 159 cases (September December 2022)

The coverage rate of gastric anatomy in clinical trial subjects is **99.8%**

The diagnostic consistency rate between the examinee and the conventional gastroscopy is **96.8%**

Conclusions

- Capsule endoscopy is a prime candidate for early adoption of AI
- Available systems:
  - Able to differentiate abnormal images from normal images
  - Efficient detection rate
  - Promising performance
  - Rapid reading time
- Prospective studies evaluating the real gain of AI-assisted CE reading on the clinical outcome are needed
- Indications (i.e. Crohn's Disease) need to be evaluated

AI will not replace endoscopists

but

those who don’t use AI will be replaced
by those who use it

Thank you


endolive roma
SAVE THE DATE !
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28-30 MAY
Course Directors: Guido Costamagna & Cristiano Spada
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