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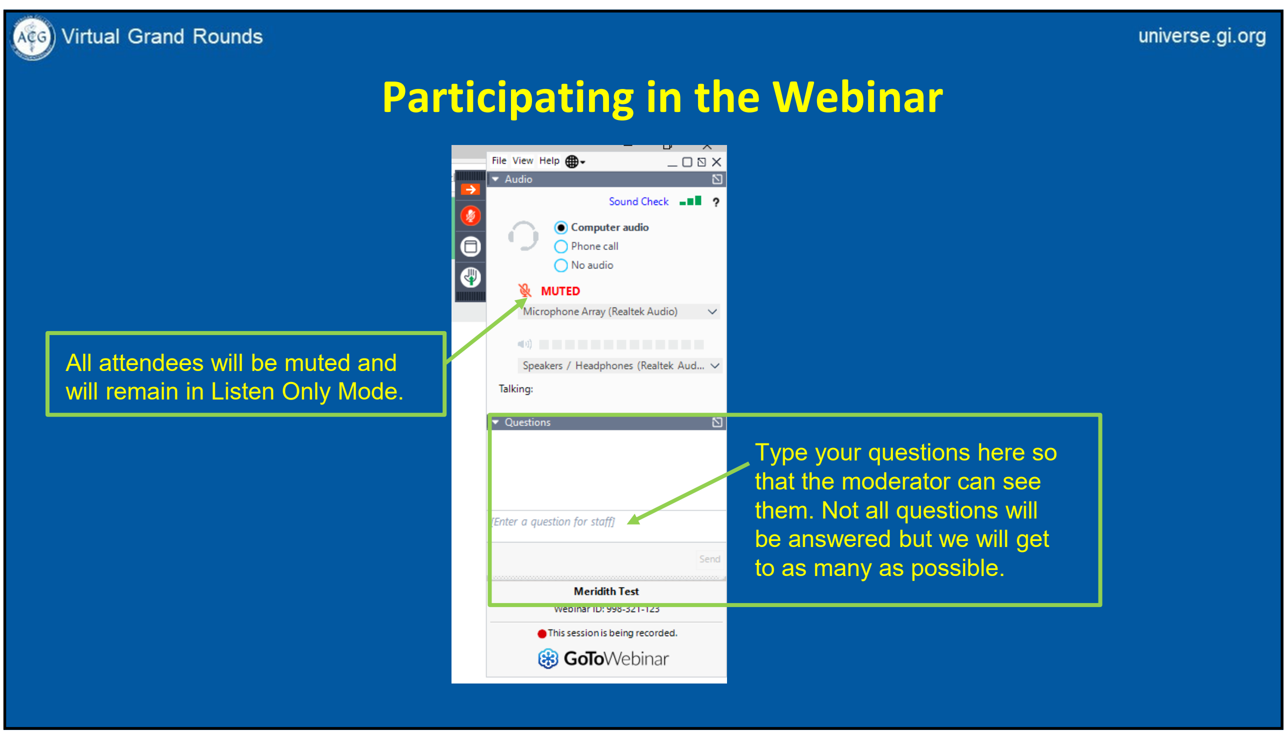
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LIVE VIRTUAL GRAND ROUNDS WEBINAR

ACG will send a link to a CME & MOC evaluation to all attendees on the live webinar.

ABIM Board Certified physicians need to complete their MOC activities by December 31, 2022 in order for the MOC points to count toward any MOC requirements that are due by the end of the year. No MOC credit may be awarded after March 1, 2023 for this activity.

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MOC QUESTION

If you plan to claim MOC Points for this activity, you will be asked to: Please list specific changes you will make in your practice as a result of the information you received from this activity.

Include specific strategies or changes that you plan to implement.
THESE ANSWERS WILL BE REVIEWED.

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ACG Virtual Grand Rounds

Join us for upcoming Virtual Grand Rounds!

Week 2 – Thursday, January 12, 2023
How Can We Close the Screening Disparity Gaps in Our Population?
Faculty: Renee L. Williams, MD, MHPE, FACG
Moderator: Loren G. Rabinowitz, MD
At Noon and 8pm Eastern

Week 3 –Thursday, January 19, 2023
Cannabis for Gastrointestinal Disorders: Everything You Wanted to Know, But Were Afraid to Ask
Faculty: Linda Anh Nguyen, MD
Moderator: Steven Carpenter, MD, FACG
At Noon and 8pm Eastern

Visit **gi.org/ACGVGR** to Register

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Disclosures

Seth A. Gross, MD, FACG
Ambu: Consultant; Ankon : Consultant; Colowrap : Consultant; Cook : Consultant; Microtech : Consultant; Motus : Consultant; Olympus : Consultant; Pentax : Consultant

Nasim Parsa, MD
Satisfai Health: Advisory Committee/Board Member; Stock Options

**All of the relevant financial relationships listed for these individuals have been mitigated*

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Artificial Intelligence (AI) in GI Endoscopy

Seth A. Gross, MD, FACG
Professor of Medicine
NYU Grossman School of Medicine
Clinical Chief of Gastroenterology and Hepatology
NYU Langone Health

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Objectives

- Discuss the value of artificial intelligence (AI)
- Review areas where AI is being applied clinically
- Go through the data for AI in colonoscopy

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Background

- Artificial intelligence (AI) continues to grow with a key goal to improve overall quality in clinical practice
- Imaged-based specialties, such as endoscopy have the most to gain
- Once technique correction is maximized for the endoscopist AI may help address clinical pain points

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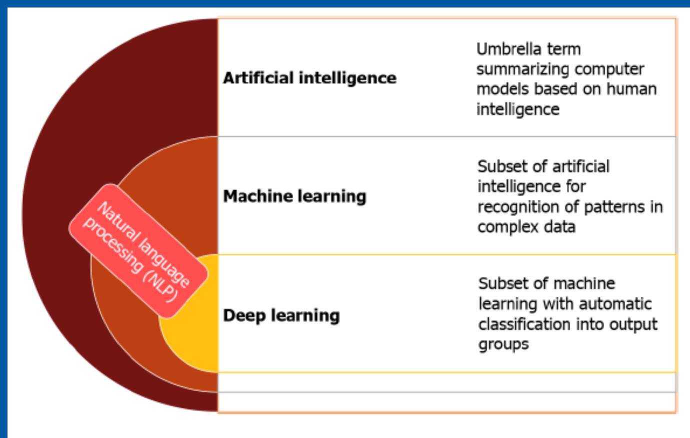
Terminology



World J Gastroenterol 2021 October 28; 27(40): 6794-6824

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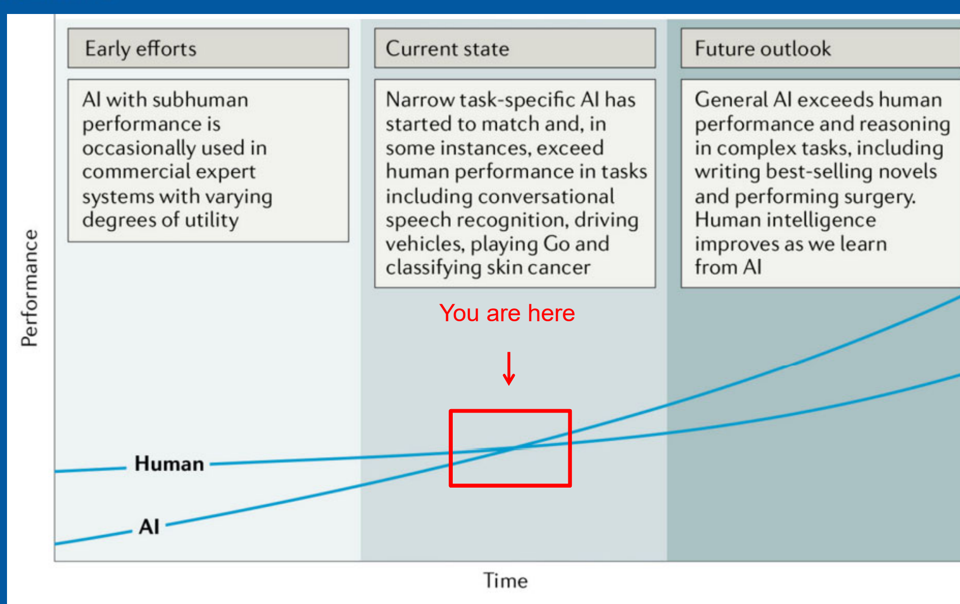

Adapted from Hosny Am J Gastro et al 2018

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AI

Augmentation vs. Automation

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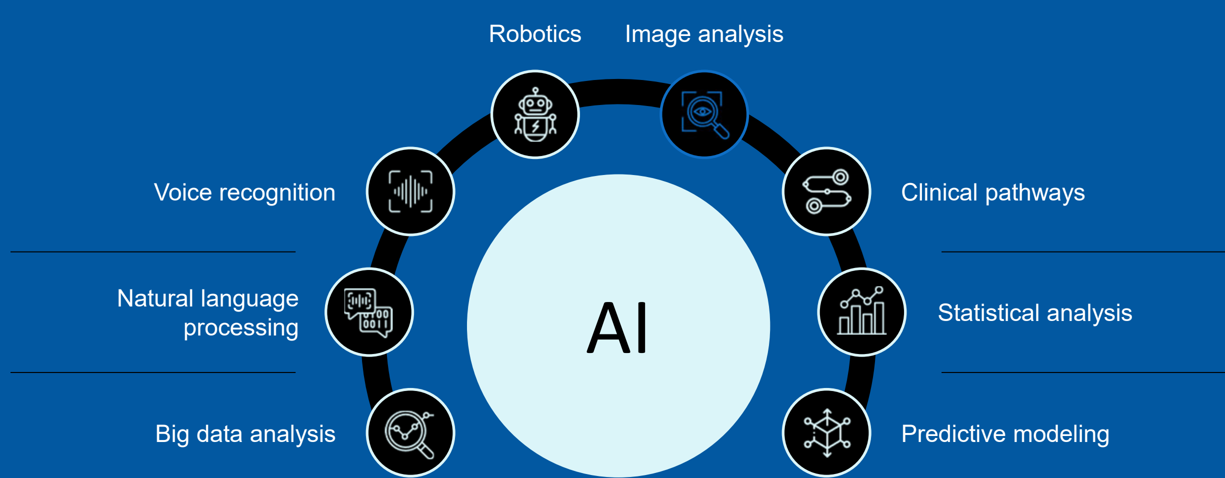
AI Applications in Health Care



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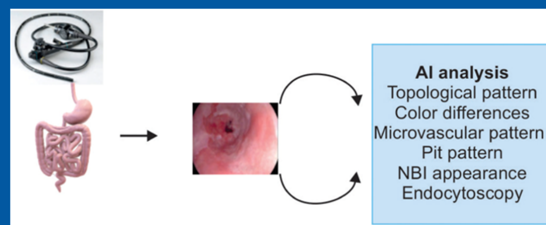
Goals of Applying of AI in Gastroenterology

- **Analyze relationships between prevention or treatment techniques and patient outcomes**
  - **Increase quality**
  - **Improve diagnostic accuracy**
  - **Decrease variance of health care delivery**
  - **Enhance outcomes**
  - **Decrease medical costs**



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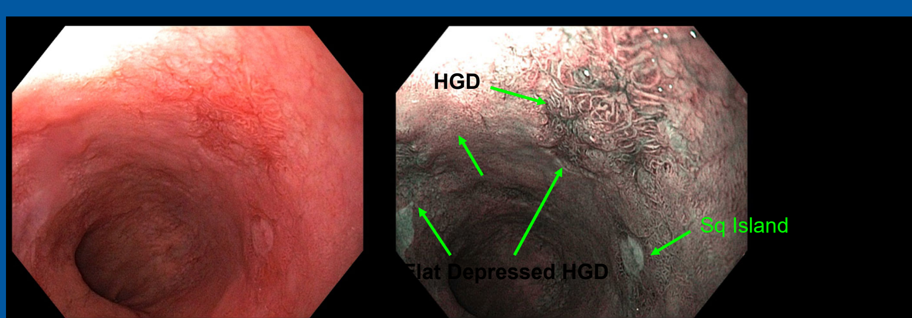
- The greatest value add for AI could be for the non-expert
- For instance, identifying the abnormality of high grade dysplasia in a segment of Barrett's esophagus



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Improving Upper Endoscopy Quality

- Barrett's Esophagus
  - Challenge:
    - Identifying dysplasia and cancer
- Esophageal Squamous Cell Carcinoma
  - Challenge:
    - Often need Lugol staining

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Surveillance of BE

- Non-adherence to Seattle protocol may lead to a significant decrease of dysplasia detection
- Many studies show that the adherence to Seattle protocol is low
  - 16% (CGH 2018; 16;862-869)
  - 24% (EIO 2018; 6: E300-E307)
- A recent meta-analysis showed a modest benefit of surveillance

CGH 2009;7:736-742
Gastro 2018;154:2068-2086

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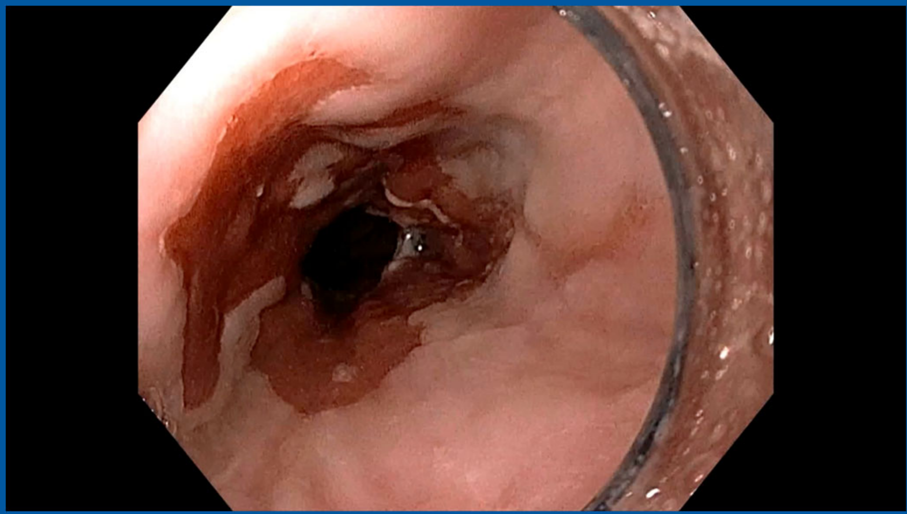
AI Assisted Barrett's Surveillance Procedure



Courtesy of Jason Samarasena, MD

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Ability to Detect Non-Dysplastic and Dysplastic Barrett's Esophagus

	Sensitivity	P value	Specificity	P value
AI diagnosis by WLI	98.6% (144/146)	0.023	88.8% (95/107)	0.0007
AI diagnosis by NBI	92.4% (73/79)		99.2% (125/126)	
AI diagnosis by standard focus	96.6% (141/146)	0.89	89.9% (98/109)	0.005
AI diagnosis by near focus	96.2% (76/79)		98.4% (122/124)	
Comprehensive AI diagnosis	96.4% (217/225)		94.2% (220/233)	

Hashimoto R, Requa J, Dao T, et al. Gastrointest Endosc. 2020 Jun;91(6):1264-1271.

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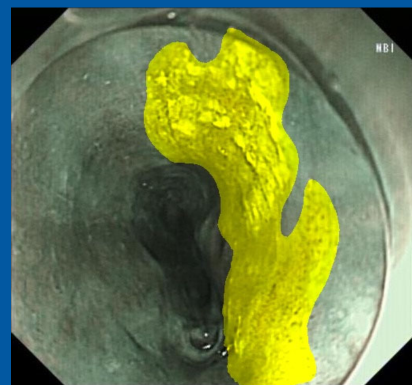
AI Identifying a Squamous Cell Dysplasia



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Sensitivities For Detecting SCC

	Lesion size			
Non-ME NBI	1-10 mm	11-30 mm	31-50 mm	≥51 mm
AI system, %	70	95.8	100	100
Experts, n/N (%)	6.7/10 (67.6)*	18.8/24 (78.5)	5.4/6 (91.0)	4.9/5 (98.4)
	Cancer invasion depth			
	Epithelium	Lamina propria	Muscularis mucosa	Submucosa
AI system, %	80	86.3	100	100
Experts, n/N (%)	2.8/5 (56.9)*	15.4/22 (70.2)	7.7/8 (97.1)	9.9/10 (99.2)

AI, Artificial intelligence; *ME*, magnifying endoscopy; *NBI*, narrow-band imaging.
*Average.

Hiromu Fukuda, MD,1 Ryu Ishihara, MD,1 Yusuke Kato, PhD,2
GASTROINTESTINAL ENDOSCOPY Volume 92, No. 4 : 2020

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TissueCypher: Risk Progression of Barrett's Esophagus

Biomarkers and Spatial biology

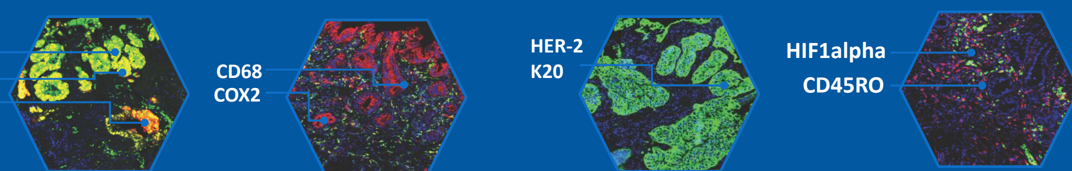
Molecular biomarkers to detect changes in the context of tissue structure prior to morphologic changes

Digital Microscopy

Vision systems that objectively and reproducibly analyze and interpret tissue structures and features

Artificial Intelligence

A risk classifier trained on a large data set to recognize progressor vs non-progressor tissue samples



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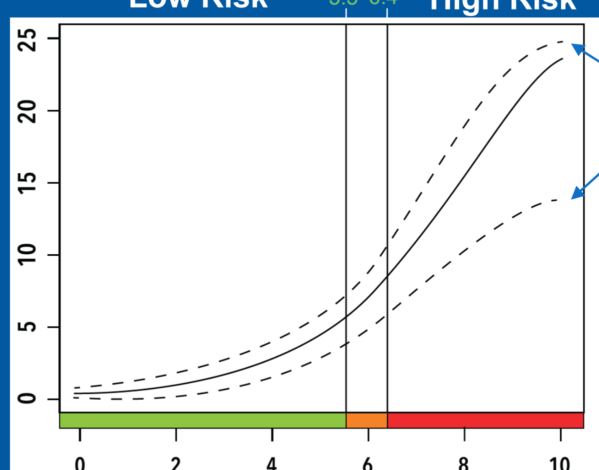
Progression Score



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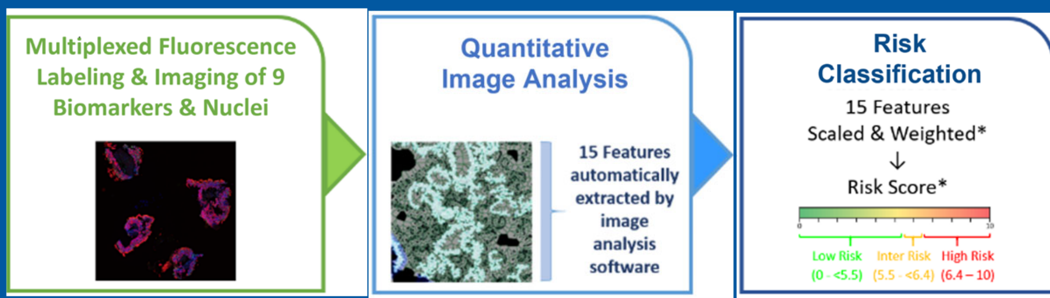
How does TissueCypher work?



[1]J Pathol Inform. 2015 Aug 31;6:48. [2]Critchley-Thorne et al., Cancer Epidemiol Biomarkers Prev. 2016 Jun;25(6):958-68.

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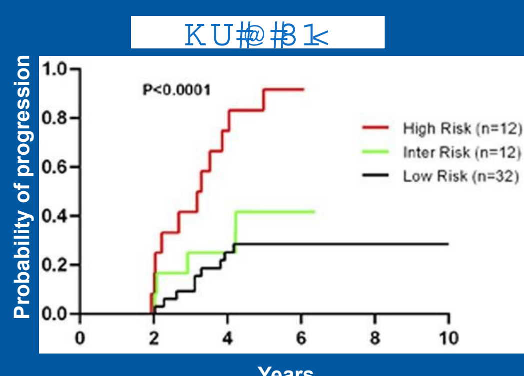
Predicts Incident Progression in Patients with Non-Dysplastic BE

- Prediction of incident progression (> 2 years after endoscopy) in 76 patients with NDBE)
- NDBE patients were at **5.9-fold** increased risk compared to patients who scored low-risk
- A subset of patients with NDBE who progress at a higher rate (6.9%/year) than patients with expert-confirmed LGD
- The test identified 50% of incident progressors to HGD/EAC at the NDBE stage



Frei et al., Independent Validation of a Tissue Systems Pathology Assay to Predict Future Progression in Non-Dysplastic Barrett's Esophagus: A Spatial-Temporal Analysis Clin Transl Gastroenterol. 2020 Oct;11(10):e00244.

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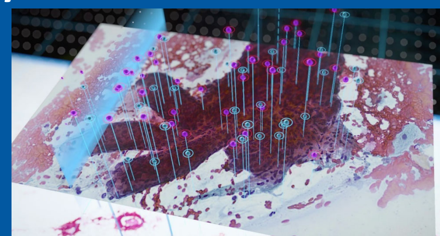
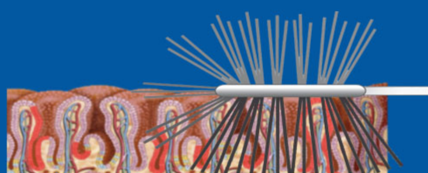
Wide-Area Transepithelial Tissue Sampling with computer-assisted 3D analysis WATS^{3D}



Wide area tissue sampling

- Samples ~90% of at-risk mucosa
- Procedure time less than 5 minutes



3D imaging analysis & AI/Machine learning

- Performs extended depth of field (EDF) analysis and produces 3D images of atypical epithelium
- Screens, identifies, and ranks atypical epithelium for pathologist

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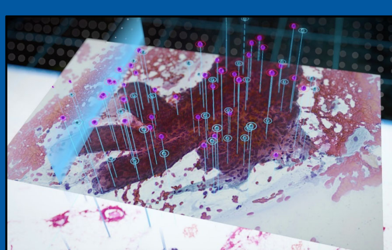

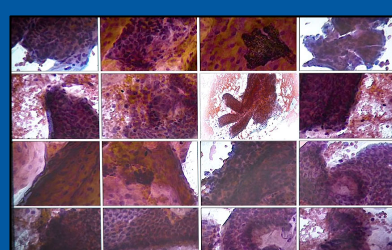

- Screens, identifies, and ranks atypical epithelium for pathologist
- Decreases pathology misses
- Increases Interobserver agreement

Diagnosis made by pathologist utilizing computer synthesized 3D images of ranked atypical epithelium combined with microscopic analysis of brush acquired formalin fixed and PAP-stained slides

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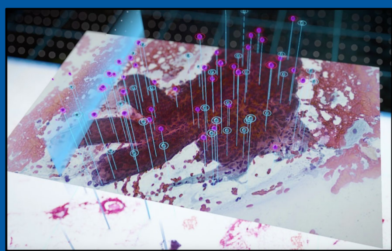
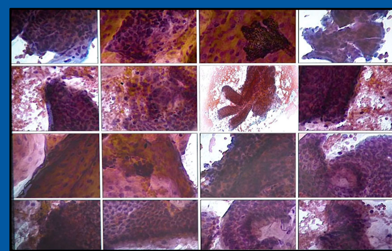
Artificial Neural Network Analysis


- Screens, identifies, and ranks atypical epithelium for pathologist
- Decreases pathology misses
- Increases Interobserver agreement

Diagnosis made by pathologist utilizing computer synthesized 3D images of ranked atypical epithelium combined with microscopic analysis of brush acquired formalin fixed and PAP-stained slides

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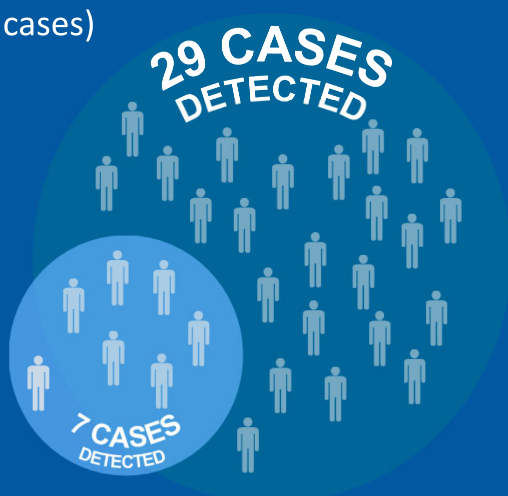
Multicenter Prospective Randomized Trial

(16 centers, 160 cases)

- WATS^{3D}
- SEATTLE PROTOCOL



- **WATS^{3D} detected an additional 23 HGD/EAC**
- **Prior Pathology**

  13 High-Grade Dysplasia
  6 Low-Grade Dysplasia
  2 Indefinite
  2 Non-Dysplastic Barrett's

Vennalaganti et al. Gastrointest Endosc. 2018;87(2):348-355

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- **Gastric Cancer**
  - Challenge
    - Differentiating cancerous and non-cancerous lesions
    - Optical detection of HP
    - Gastric ulcer

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Diagnostic performance of the CAD system for gastric cancer and noncancer

	Experience in endoscopy (years)	Accuracy, % (95% CI)	*P* value (vs CAD)	Sensitivity, % (95% CI)	*P* value (vs CAD)	Specificity, % (95% CI)	*P* value (vs CAD)
CAD system		85.1 (79.0-89.6)		87.4 (78.8-92.8)		82.8 (73.5-89.3)	
Expert 1	>10	85.1 (79.0-89.6)	>.9999	94.2 (87.2-97.5)	.0833	75.9 (65.9-83.6)	.2568
Expert 2	5-10	87.9 (82.3-92.0)	.4233	85.1 (76.1-91.1)	.6374	90.8 (82.9-95.3)	.1266
Expert 3	5-10	84.5 (78.4-89.1)	.8694	70.1 (59.8-78.7)	.0011*	98.9 (93.8-99.8)	.0005†
Expert 4	5-10	88.5 (82.9-92.4)	.3304	85.1 (76.1-91.1)	.6374	92.0 (84.3-96.0)	.0736
Expert 5	>10	86.2 (80.3-90.6)	.7456	90.8 (82.9-95.3)	.4054	81.6 (72.2-88.4)	.8415
Expert 6	>10	87.4 (81.6-91.5)	.7456	79.3 (69.6-86.5)	.1266	95.4 (88.8-98.2)	.0076†
Expert 7	>10	82.8 (76.5-87.6)	.4652	83.9 (74.8-90.2)	.4054	81.6 (72.2-88.4)	.8084
Expert 8	>10	71.3 (64.1-77.5)	.0013*	88.5 (80.1-93.6)	.7963	54.0 (43.6-64.1)	<.0001*
Expert 9	>10	92.0 (86.9-95.1)	.029†	90.8 (82.9-95.3)	.4386	93.1 (85.8-96.8)	.029†
Expert 10	5-10	78.2 (71.5-83.7)	.0897	67.8 (57.4-76.7)	.0016*	88.5 (80.1-93.6)	.2752
Expert 11	>10	58.0 (50.6-65.1)	<.0001*	54.0 (43.6-64.1)	<.0001*	62.1 (51.6-71.5)	.0027*

The McNemar test was used to compare the accuracy, sensitivity, and specificity between the CAD system and the experts.
CAD, Computer-aided diagnosis; *CI*, confidence interval.
*The CAD system is significantly more accurate than the expert.
†The CAD system is significantly less accurate than the expert.

Yusuke Horiuchi, MD, PhD,1 Toshiaki Hirasawa, MD,1 Naoki Ishizuka, PhD,2 Yoshitaka Tokai, MD,1. GASTROINTESTINAL ENDOSCOPY Volume 92, No. 4 : 2020

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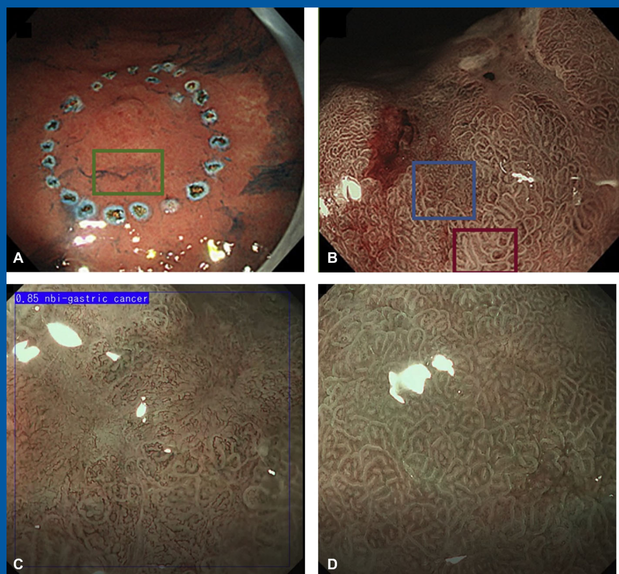

The blue square represents the cancerous lesion, and the red square represents the noncancerous tissue

Gastrointestinal Endoscopy 2020 92856-865.e1DOI: (10.1016/j.gie.2020.04.079)

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Capsule Endoscopy (CE) and AI

- CE has been around since 2001
- Advances have included:
  - Suspected blood indicator (2003)
    - Sensitivity about 60% for active bleeding
  - Adaptive frame rate to improve resolution
  - Quick-view, attempts to select most relevant images
    - Top 10% out of 50,000 to 60,000 frames
  - Readers are not perfect with limited attention

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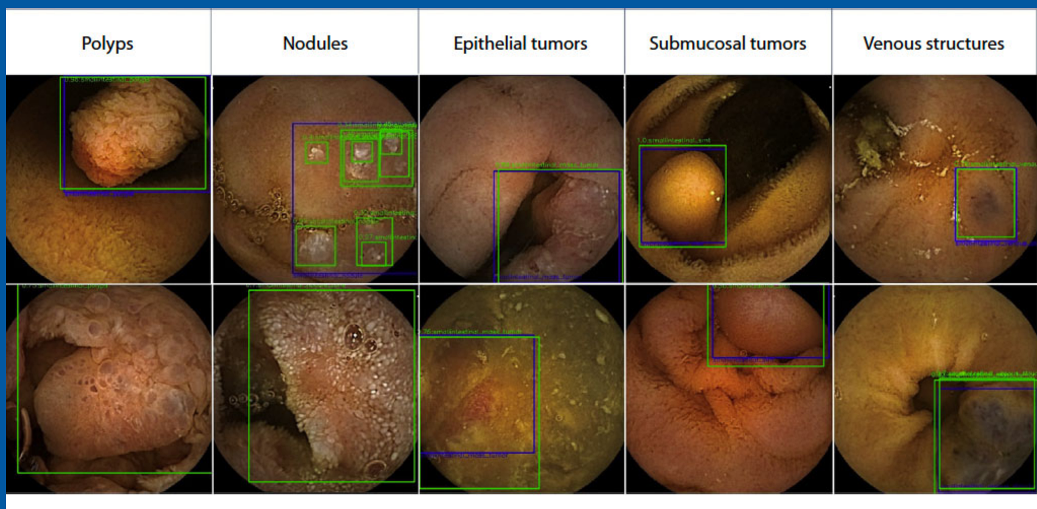
AI Capsule Endoscopy



Saito H, et al. GIE. 2020

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AI Impact on Reading Speed

- Training data
  - 158,235 SB-CE images from 1970 patients
- Validation data (retrospective)
  - 113,268,334 images from 5000 patients

The deep learning model based on CNN identified abnormalities with a sensitivity of 99.88% in per-patient and 99.90% in per lesion analysis

Ding et al. Gastroenterology 2019

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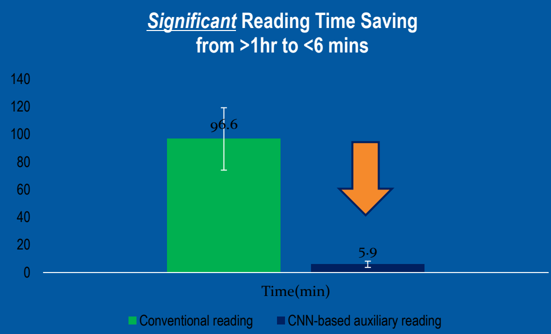

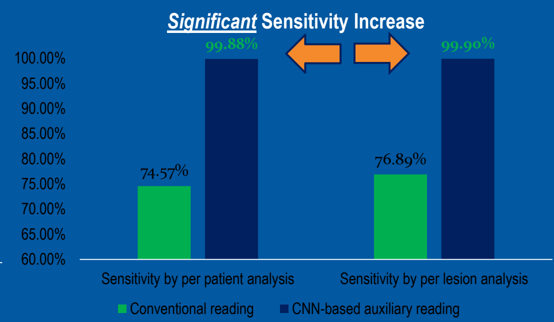

Gastroenterology 2019;157:1044-1054

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eP211 DIAGNOSTIC ACCURACY OF CAPSULE ENDOSCOPY READING ASSISTED BY ARTIFICIAL INTELLIGENCE FOR EXPERT READERS: INTERIM ANALYSIS OF A SINGLE CENTER EXPERIENCE

Aims

- Artificial Intelligence (AI) promises to revolutionize Capsule Endoscopy (CE) by reducing reading time while maintaining high diagnostic accuracy. Primary aim was to compare the diagnostic accuracy of AI-assisted reading with Standard Reading (SR) when both are performed by expert readers (>500 cases) for detection of significant pathology of the small bowel. Secondary aim was to compare mean reading time of both reading modalities.

Results

- 19 out of 20 patients who underwent SBCE had a complete SB examination and were included in the interim per-patient analysis. SR and AI-assisted reading detected the same small bowel pathology in 15 patients and no pathology in the remaining 4 patients. Sensitivity, specificity, positive and negative predictive values of AI-based reading compared to SR were 100%. Mean SB reading time in SR and AI are reported in the following table.

S. Piccirelli[1,2], A. Bizzotto[2], E.V. Pesatori[1,2], D. Salvi[1,2], E. Tettoni[1,2], N. Belluardo[1,2], C. Spada[1,2]
[1]Università Cattolica del Sacro Cuore, Rome, Italy, [2]Fondazione Poliambulanza Istituto Ospedaliero, Internal Medicine, Gastroenterology and Digestive Endoscopy, Brescia, Italy

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AI-Assisted Capsule Reading:

- Showed high diagnostic accuracy in detection small bowel pathology
- A significant reduction of reading time

	Standard Reading (SR)	AI-assisted Reading
Mean reading time ±SD	41.25 min ± 14.14	4.75 min ± 2.86

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Lower GI Tract

- Colon cancer screening and surveillance
  - Challenge
    - Missed colon polyps
    - Optical diagnosis
    - Polyp size estimations

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Image Classification Can Be challenging!
The "dog or food?" challenge

Source: Teenybiscuit and Chuck Larson

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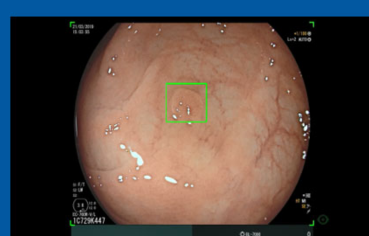
- FDA approved AI technology:
  - Medtronic
    - GI Genius
  - Micro-Tech
    - Wision



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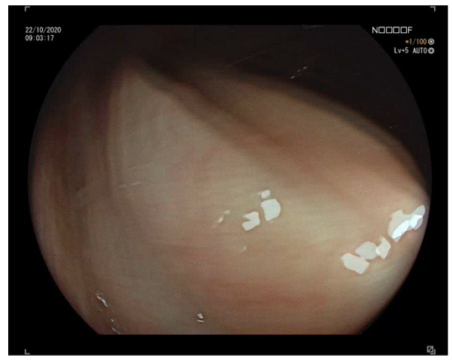
AI in Colonoscopy



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A Retrospective Analysis of 338 White Light Videos

Hassan et al GUT 2019.

99.7%
sensitivity

82%
faster polyp recognition than the endoscopist (RT)*

<1%
false activation

- **Objective:**
  To assess the detection accuracy and reaction time of a new AI system
- **Sensitivity:**
  337 true-positives and 1 false-negative per lesion
- **Speed:**
  AI detected polyps before the average endoscopist in 277/337
- **Reaction time:**
  5 expert endoscopists each observed video clips pressing a button as soon as they detected the appearance of a polyp. AI's earliest detection of each polyp was compared against the mean RT of the 5 reviewers for the same polyp
- **False positives:**
  The average number of frames per video showing a false positive detection
- **Study conclusion:**
  Achieved overall sensitivity per lesion of 99.7% (337 true positives and 1 false negative). The false positive rate was nearly negligible at less than 1%

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Efficacy of Real-Time Computer-Aided Detection of Colorectal Neoplasia in a Randomized Trial

Study Design: This was a parallel, randomized, multicenter trial performed in 3 sites in Italy that participated in the organized population CRC screening program.

ADR	
Baseline	40%
ADR Increase	**14% Increase**
APC Increase	46% Increase

Morphology	
Flat	42% Increase
Polypoid	36% Increase
Location	
Proximal	26% Increase
Distal	53% Increase
Size	
6-9mm	78% more likely to detect
<5mm	26% more likely to detect

CADe **did not increase the withdrawal time** and there were no differences in nonneoplastic resection rates between the groups suggesting it is equivalent to current best practice.

REPICI, A., BADALAMENTI, M., MASELLI, R., ET AL. GASTROENTEROLOGY. 2020

49

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Computer Aided Detection Tandem Colonoscopy Study: CADeT-CS Trial

Character	CADe-first (n = 113)	HDWL-first (n = 110)	P-value	OR	95% CI
Polyp, total	285	264	.5612[a]	0.9516	0.8049–1.1250
Miss rate, %	20.70 (59/285)	33.71 (89/264)	.0007	1.9481	1.3273–2.8592
Adenoma, total	169	144	.2403[a]	0.8753	0.7009–1.0932
Miss rate, %	20.12 (34/169)	31.25 (45/144)	.0247	1.8048	1.0780–3.0217
Hyperplastic polyp, total	55	41	.1959[a]	0.7658	0.5111–1.1475
Miss rate, %	23.64 (13/55)	39.02 (16/41)	.1071	2.0677	0.8546–5.0029
Sessile serrated lesions	14	19	.3455[a]	1.3942	0.6990–2.7805
Miss rate, %	7.14 (1/14)	42.11 (8/19)	.0482	9.4545	1.0181–87.7969
Advanced adenoma,[b] total	9	5	.3146[a]	0.5707	0.1913–1.7029
Miss rate, %	11.11 (1/9)	0.00 (0/5)	.9971	<0.0001	<0.0001–inf

CADe, Computer-aided detection; CI, confidence interval; HDWL, high-definition white light; OR, odds ratio.
[a]Calculated using Poisson regression.
[b]Advanced adenoma is defined as adenoma size ≥10 mm.

- First-pass APC was higher in the CADe-first group 1.19 vs 0.90 HDWL
- First-pass ADR was 50.44% in the CADe-first group and 43.64 % in the HDWL-first group (P [.3091)

Brown JR,* Nabil M. Mansour NM,‡ Pu Wang P, et al.. Clinical Gastroenterology and Hepatology 2021

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Meta-analysis of Prospective AI Trials

- 5 randomized trials were eligible for analysis.
- ADR with AI was 29.6 % versus 19.3 % without AI
- No difference in detection of advanced adenomas
- Mean APC was higher for small adenomas (≤ 5 mm) for AI versus non-AI (mean difference 0.15 [0.12 – 0.18])
- Not higher for larger adenomas
  - > 5 – ≤ 10 mm, mean difference 0.03 [0.01 – 0.05];
  - > 10 mm, mean difference 0.01 [0.00 – 0.02]
- Increased detection of small nonadvanced adenomas and polyps, but not of advanced adenomas

Barua I, Guerrero Vinsard DG, Jodal HC. Endoscopy 2021; 53(03): 277-284

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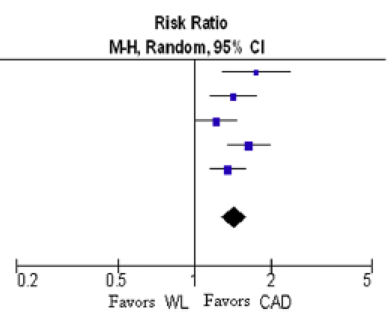
Meta–Analysis AI Trials

ADR

	CAD		WL			Risk Ratio
Study or Subgroup	**Events**	**Total**	**Events**	**Total**	**Weight**	**M-H, Random, 95% CI**
Su et al , 2020	89	308	52	315	11.7%	1.75 [1.29 - 2.37]
Wang et al , 2019	151	522	109	536	18.8%	1.42 [1.15 - 1.76]
Wang et al , 2020	165	484	134	478	21.7%	1.22 [1.01 - 1.47]
Liu et al , 2020	199	508	124	518	22.0%	1.64 [1.36 - 1.97]
Repici et al , 2020	187	341	139	344	25.8%	1.36 [1.16 - 1.59]
Total (95% CI)		**2163**		**2191**	**100.0%**	**1.44 [1.27 - 1.62]**
Total events	791		558			

Heterogeneity: Tau² = 0.01; Chi² = 6.91, df = 4 (P = .14); I² = 42%

Test for overall effect: Z = 5.93 (P < .00001)



Hassan C, Spadaccini M, Iannone A, GASTROINTESTINAL ENDOSCOPY Volume 93, No. 1 : 2021

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Impact of AI Based on Lesion Size

TABLE 2. Adenoma detection subgrouped according to size, location, and morphology

Reference	Adenoma <5 mm Control	Adenoma <5 mm CAD	Adenoma <5 mm *P* value	Adenoma 6-9 mm Control	Adenoma 6-9 mm CAD	Adenoma 6-9 mm *P* value	Adenoma ≥10 mm Control	Adenoma ≥10 mm CAD	Adenoma ≥10 mm *P* value
Wang et al[11]	102 (63.8)	185 (70.6)	<.05	50 (31.6)	61 (23.3)	ns	8 (5.0)	16 (6.1)	ns
Wang et al[21]	128 (71)	211 (75)	<.05	46 (25)	60 (21)	ns	7 (4)	10 (4)	ns
Repici et al[10]	164 (74.5)	234 (73.1)	<.05	28 (12.7)	55 (17.2)	<.05	28 (12.7)	31 (9.7)	ns
Liu et al[23]	89 (62.7)	166 (66.4)	<.05	43 (30.3)	63 (25.2)	ns	10 (7.0)	21 (8.4)	ns
Su et al[22]	37 (66.1)	72 (63.7)	<.05	\	\	\	\	\	\

Values are n (%).
CAD, Computer-aided diagnosis; *ns*, not statistically significant; \, not available.

Hassan C, Spadaccini M, Iannone A, GASTROINTESTINAL ENDOSCOPY Volume 93, No. 1 : 2021

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Beyond ADR – Value of AI

- AI never has endoscopist fatigue
- Makes you more efficient
- AI keeps an eye on the target
  - When getting tools for polypectomy
- If you lose site of the polyp AI assistance potentially can find it faster
- Reduce procedure quality variation amongst providers

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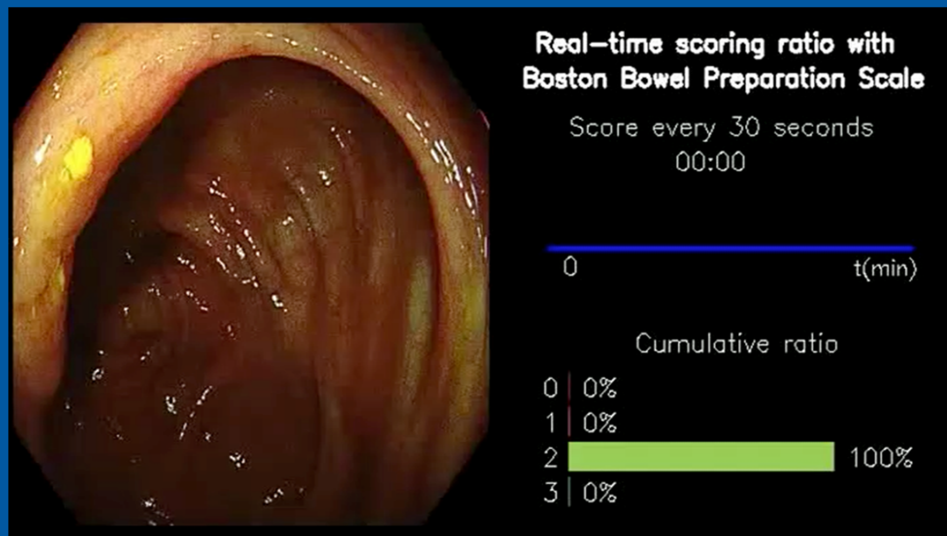
AI Bowel Prep Analysis

- 93% accurate



Zhou J, Wu L, Wan X, et al
GASTROINTESTINAL ENDOSCOPY
Volume 91, No. 2 : 2020

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Colon Cancer Depth of Invasion

- **Test set: 7,734 images (657 lesions)**
- **Validation set: 1,631 images (156 lesions)**
- **Non-magnified WLE**
- **CNN – GoogLeNet**

	Predicting non-invasive
Sensitivity	91% (89-93%
Specificity	91% (89-93%)
AUROC	0.97 (0.96-0.98)

Xiaobei et al GIE 2021

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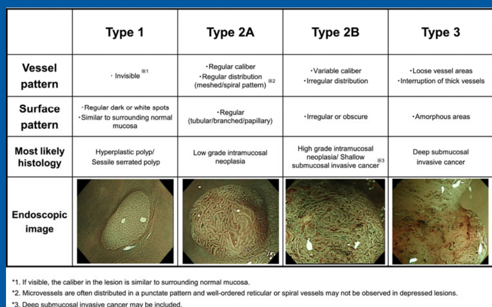
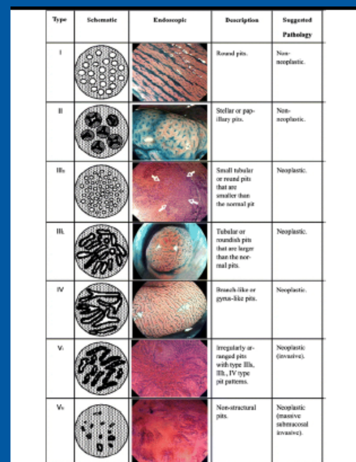
Polyp Classification

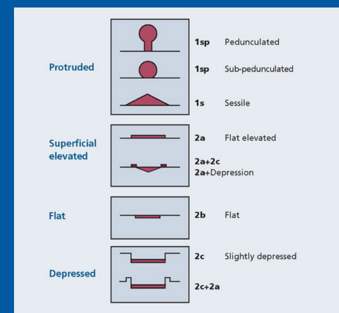


	Type 1	Type 2A	Type 2B	Type 3
Vessel pattern	· Invisible ※1	·Regular caliber ·Regular distribution (meshed/spiral pattern) ※2	·Variable caliber ·Irregular distribution	·Loose vessel areas ·Interruption of thick vessels
Surface pattern	·Regular dark or white spots ·Similar to surrounding normal mucosa	·Regular (tubular/branched/papillary)	·Irregular or obscure	·Amorphous areas
Most likely histology	Hyperplastic polyp/ Sessile serrated polyp	Low grade intramucosal neoplasia	High grade intramucosal neoplasia/ Shallow submucosal invasive cancer ※3	Deep submucosal invasive cancer
Endoscopic image				

*1. If visible, the caliber in the lesion is similar to surrounding normal mucosa.
*2. Microvessels are often distributed in a punctate pattern and well-ordered reticular or spiral vessels may not be observed in depressed lesions.
*3. Deep submucosal invasive cancer may be included.



Type	Schematic	Endoscopic	Description	Suggested Pathology
I			Round pits.	Non-neoplastic.
II			Stellar or papillary pits.	Non-neoplastic.
IIIs			Small tubular or round pits that are smaller than the normal pit	Neoplastic.
IIIL			Tubular or roundish pits that are larger than the normal pits.	Neoplastic.
IV			Branch-like or gyrus-like pits.	Neoplastic.
VI			Irregularly arranged pits with type IIIs, IIIL, IV type pit patterns.	Neoplastic (invasive).
VN			Non-structural pits.	Neoplastic (massive submucosal invasive).



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Polyp Classification Tools

- Magnification endoscopy
- Chromoendoscopy
  - Dye based
  - Virtual
- Confocal laser endomicroscopy

Disadvantages

- Training
- Time
- Cost
- Further validation and adoption of these classification strategies may support a “resect and discard” or a “diagnose and leave” strategy

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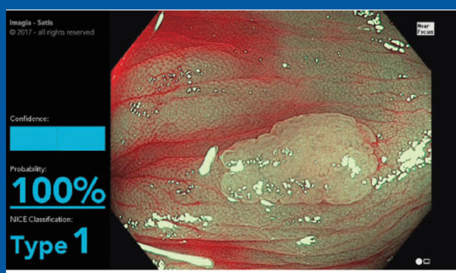
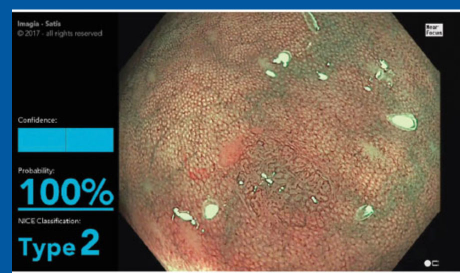
Colon Polyps
Differentiating Hyperplastic vs Adenoma
Nice Classification





Byrne MF,
Chapados N, Soudan F, et al.
Gut 2019;68:94–100.

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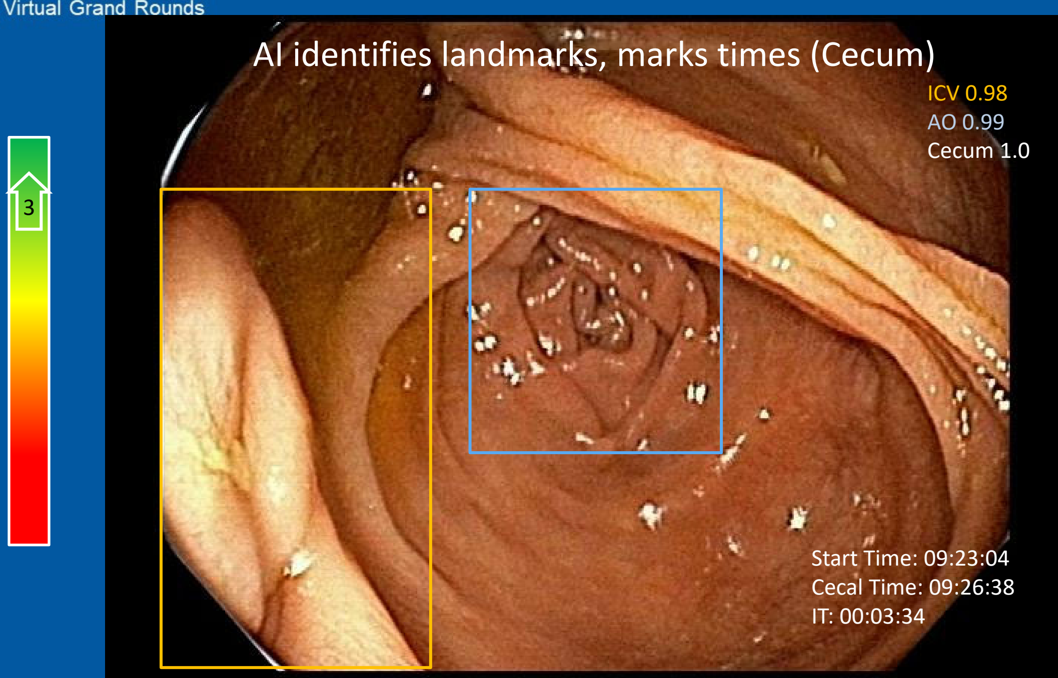

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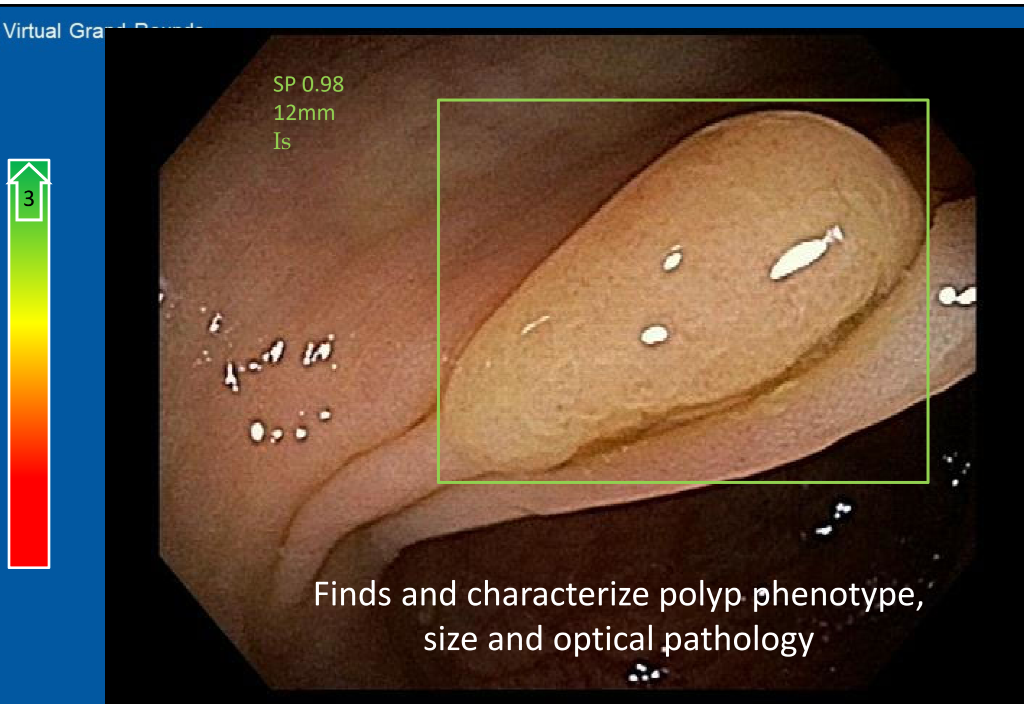
Virtual Gra[…] universe.gi.org



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Other Areas of AI Impact

- Inflammatory Bowel Disease
  - Challenge
    - Detecting Crohn's disease on capsule endoscopy
    - Assessing disease activity of ulcerative colitis (UC)
    - Optical marker of remission
    - Detecting dysplasia in chronic UC patients
    - Identifying patients for clinical trials

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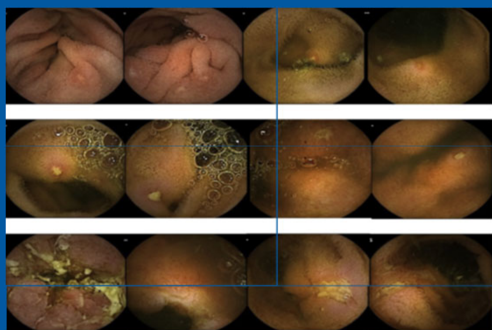
Ulcer Severity in CD



Mild

Moderate

Severe

- Retrospectively reviewed CE images of CD ulcers
  - Experiment 1: 2 CE readers graded ulcer severity
  - Experiment 2: A consensus reading by 3 CE readers was used to train an ordinal CNN
- Results:
  - 91% accurate for grade 1 ulcer vs grade 3 ulcer
  - 78% accurate for grade 2 ulcer vs grade 3 ulcer
  - 62% accurate for grade 1 ulcer vs grade 2 ulcer

Ulcers with the panenteric Pillcam Crohn's Capsule: Overall accuracy 98.8%

Ferreira et al

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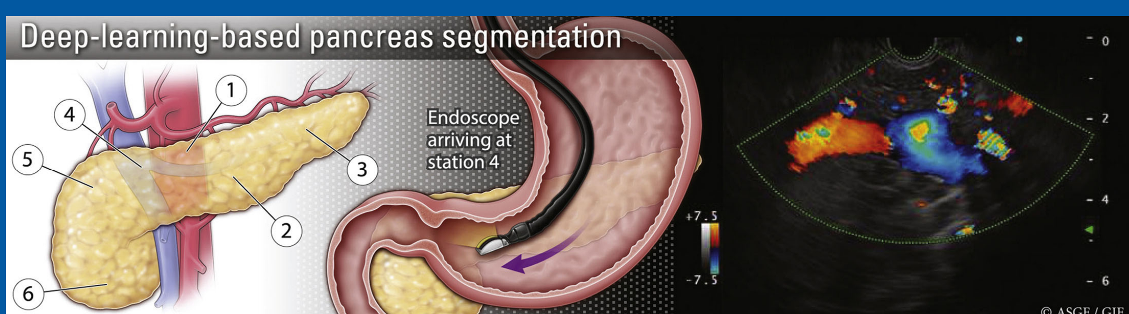
AI and Endoscopic Ultrasound



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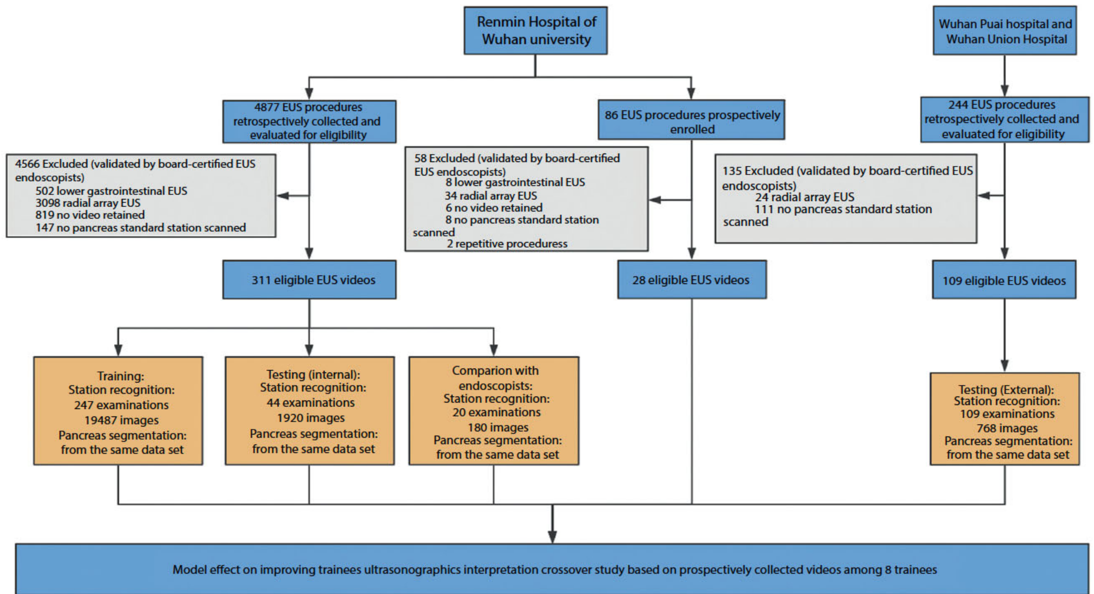

Jun Zhang,1,2,3 Liangru Zhu,4 Liwen Yao,1Volume 92, No. 4 : 2020 GASTROINTESTINAL ENDOSCOPY

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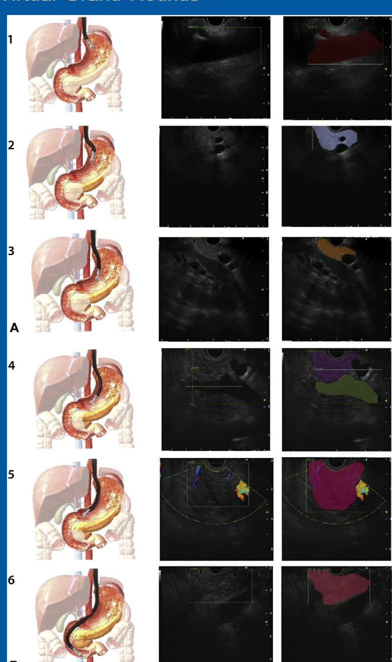

Station 1: Abdominal aorta

Station 2: Pancreatic body

Station 3: Pancreatic tail

Station.4: Confluence

Station 5: Pancreatic head from stomach

Station 6: Pancreatic head

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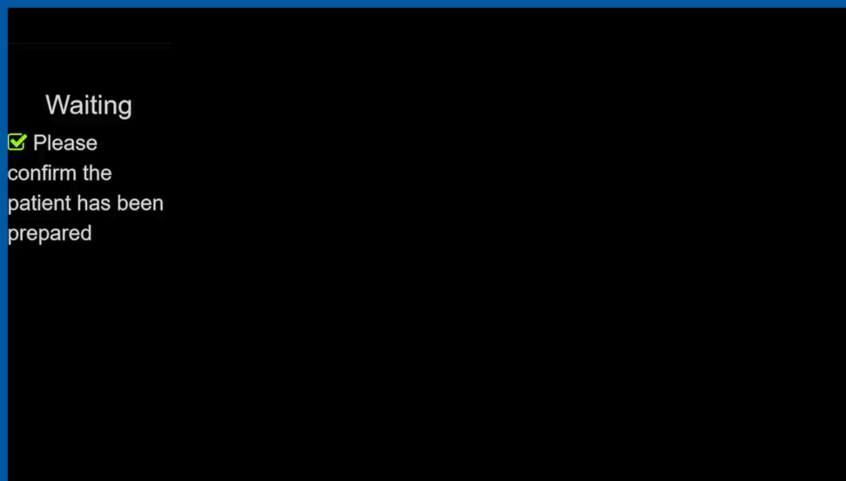
AI Identifying Key EUS stations



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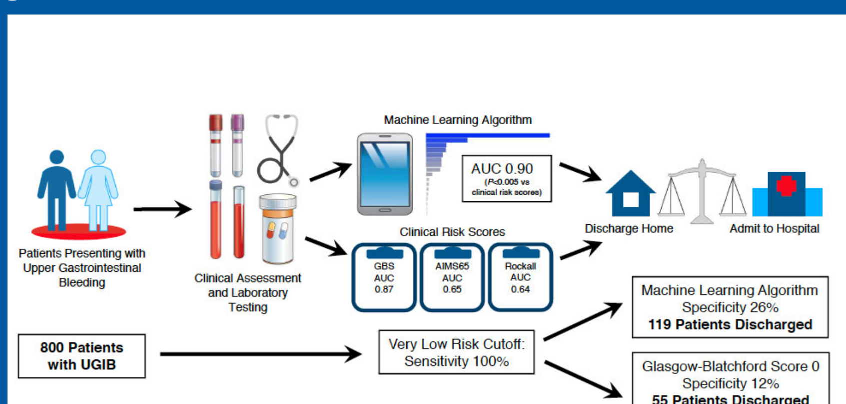
AI Analyzing Medical Record Data To Risk Stratify Patients



Shung D. Digestive Diseases and Sciences (2019) 64:2078–208

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AI In Hepatology

- Prognostic Disease Progression:
  - Banerjee et al developed an ANN with 22 clinical and biochemical inputs of 92 all-cause cirrhotic patients which was 91% accurate (95% CI 83–98%)
- Sclerosing Cholangitis Risk Estimate Tool (PREsTO)
  - 509 PSC patients
  - C-statistic of 0.96 for predicting liver-related event or liver-related mortality in 5 years
- Accurate diagnosis and characterization of liver lesions:
  - Yasaka et al developed a CNN model of 1,068 CT images from 460
  - AUROC of 0.84 using triphasic images validation cohort to delineate images into one of five categories:
    - Category A—classic HCC Category B—malignant liver tumor other than HCC
    - Category C—Indeterminate masses Category D—hemangiomas
    - Category E—cysts
      - AUROC of 0.92
- Assessment of Nonalcoholic Steatohepatitis
  - Several groups have utilized ML techniques to create an algorithm that grade the key histological features of NASH ina continuous fashion

Artificial intelligence in Hepatology Vaz et al. Seminars in Liver Disease Vol. 41 No. 4/2021

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AI Pitfalls

- There is a dogma in the field of research—"garbage in, garbage out"—
- Understanding that the robustness and validity of the end product of a study are linked to the quality of the input data
- Accuracy of an AI model is dependent on high-quality dataset that is representative of the population the model is planned to be used on
- Ideally, large amounts of data are required to allow the system to learn and minimize errors
- In the past, this has been the Achilles' heel to ubiquitous use of ML and DL models within the field of medicine
- However, with the advent of the electronic health record and computer systems with the capacity to store and process large amounts of data

Beam AL, Kohane IS. Big data and machine learning in health care.
JAMA 2018;319(13):1317–1318

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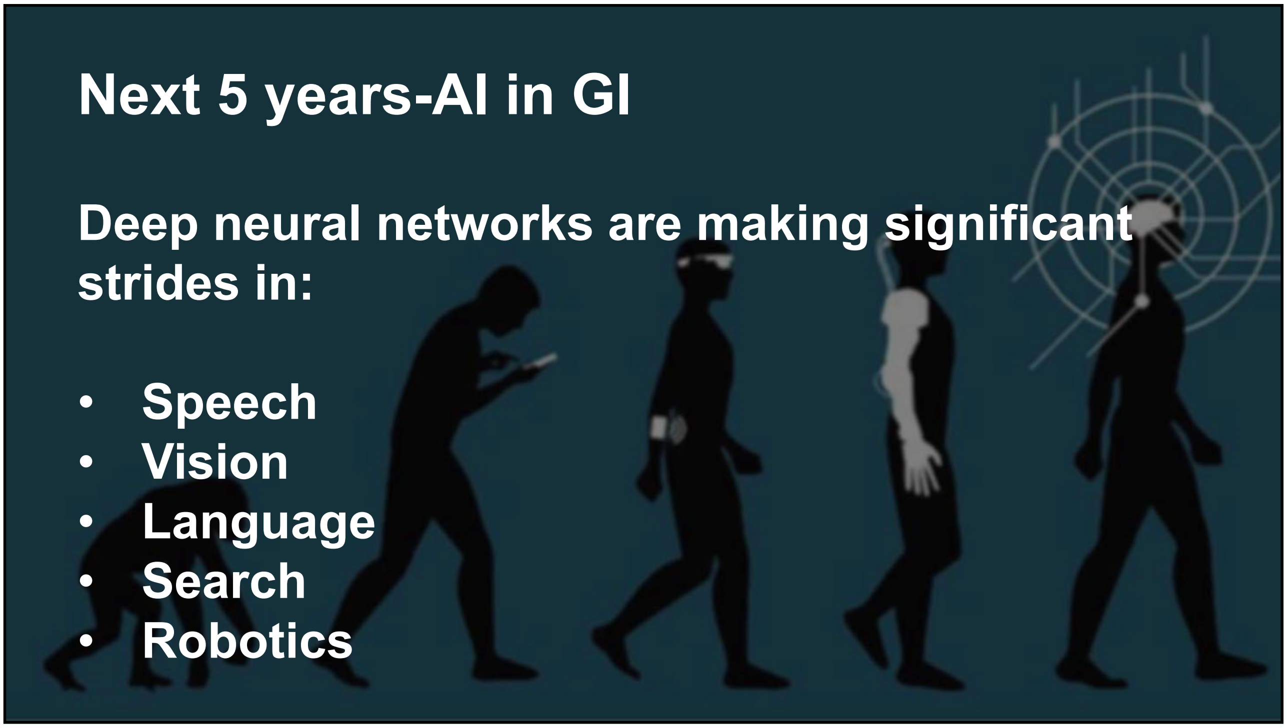

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Example Queries of the Future

Is this a tubular adenoma or SSA and what is the size?

Transcribe my note and send instructions to patient in Spanish

Hey GIAI! Pull up endoscopic images of neuroendocrine tumors of the pancreas

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Final Thoughts

- AI has the potential to improve an endoscopist's performance for detection of pre-cancerous and cancerous lesion of the luminal GI tract
- Ultimately, as AI platforms mature there is an opportunity to not only improve quality metrics, but streamline the entire procedure experience
- AI will go beyond endoscopy and be a key element in patient care

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Questions?

Seth A. Gross, MD, FACG

Nasim Parsa, MD

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GI
ACG Hepatology Circle
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