



Institute of Biomaterials
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A double-edged sword: Advancements and complications of machine learning in healthcare.

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What is Machine Learning?

- ◎ Branch of artificial intelligence (AI)
- ◎ Computers “learn” by analyzing large and diverse datasets to train themselves on performing certain tasks
- ◎ Used in predictive decision-making and pattern recognition

Article | Published: 10 October 2018

Development and validation of a deep-learning algorithm for the detection of polyps during colonoscopy

TECHNOLOGY

AI's Potential to Diagnose and Treat Mental Illness

by Parie Garg and Sam Glick

OCTOBER 22, 2018

Changing the game: Machine learning in healthcare

Deep learning algorithm detects
Alzheimer's up to six years before
doctors



Rich Haridy | November 7th, 2018

DIAGNOSTIC IMAGING | RESEARCH UPDATE

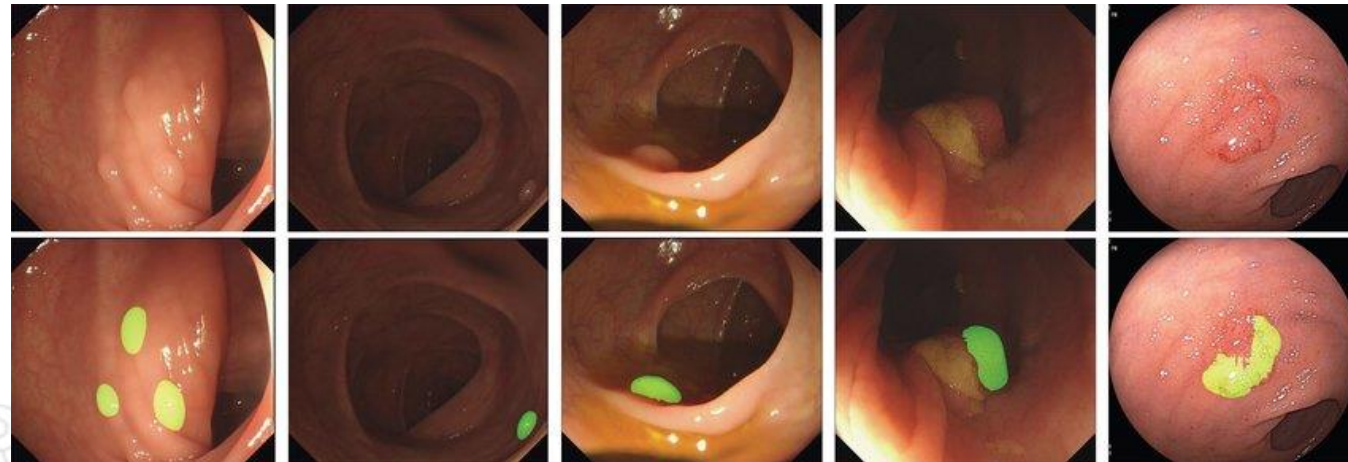
Machine learning provides insight into the human brain

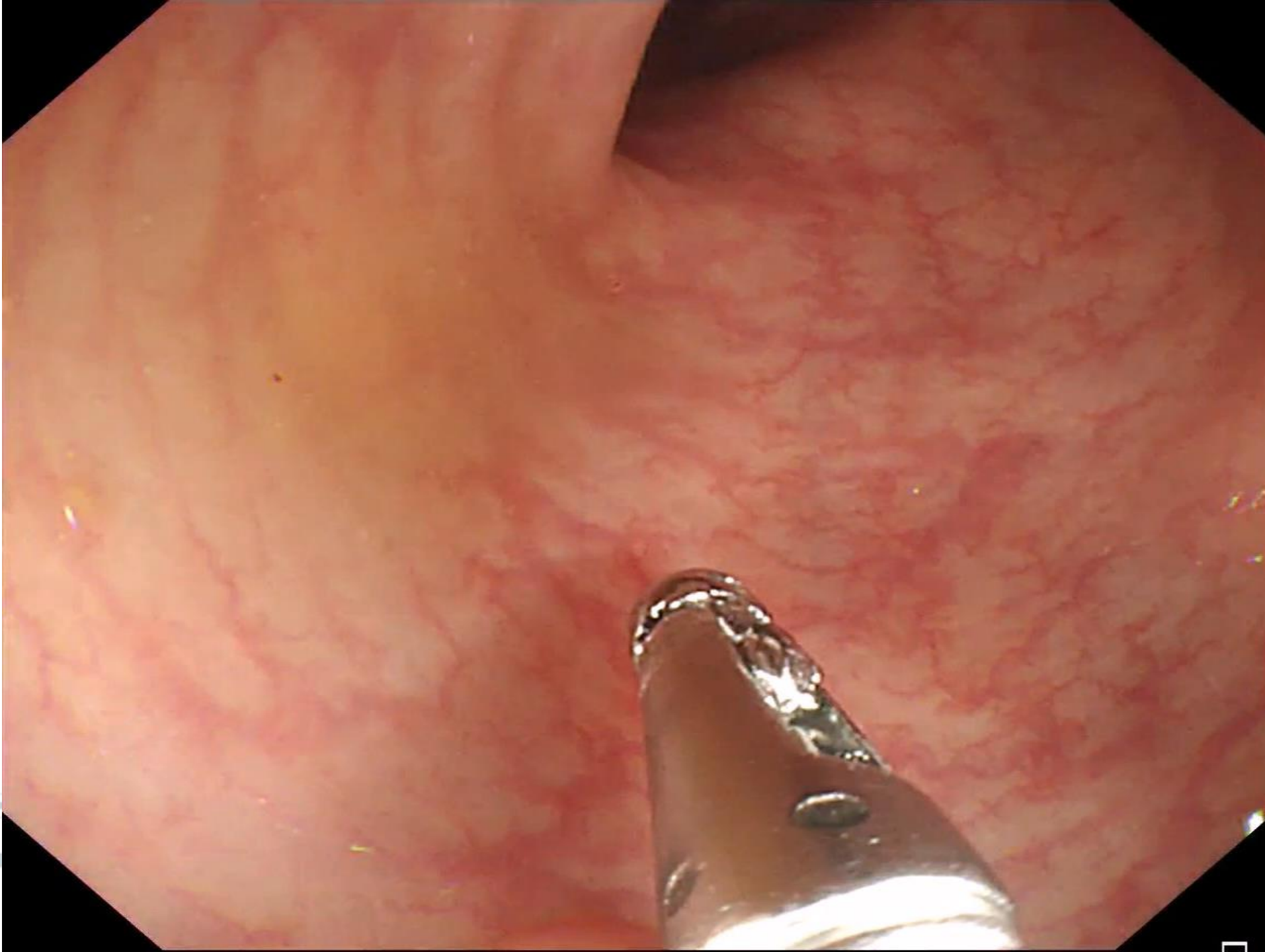
11 Jan 2019 Tami Freeman

Polyp Detection During Colonoscopy

P. Wang et al. (2018)

- ◎ 6 – 27% of adenomas are missed during colonoscopy
- ◎ Algorithm trained using 5,545 colonoscopy images from 1,290 patients
- ◎ Validated on 1,138 patients using image and video analysis
 - **Image analysis:** Sensitivity = 94.38%; specificity = 95.92%
 - **Video analysis:** Sensitivity = 91.64%





Prediction of CV Risk Factors from Retinal Images

R. Poplin et al. (2018)

- ◎ Prediction of various risk factors:
 - ◎ Age
 - ◎ Gender
 - ◎ Smoking status
 - ◎ Blood pressure (systolic and diastolic)
 - ◎ Major adverse cardiac events (MACE) within 5 years
- ◎ Algorithm trained using data from 284,335 patients
- ◎ Validated on 13,025 patients
- ◎ Prediction of MACE compared to European SCORE model

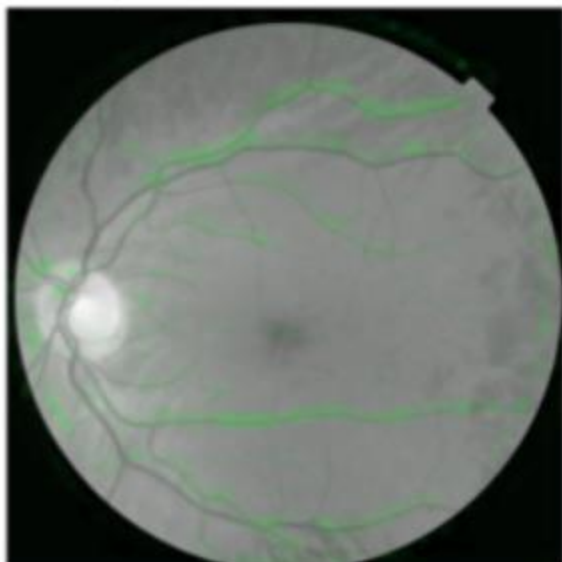


A

Original image



Masked image



B

This mask seems to be highlighting (check all that apply): *

- Veins
- Venules
- Arteries
- Arterioles
- Vessel surroundings
- AV nicks
- Optic disc
- Optic disc edges
- Drusen
- Retinal pigment
- Image edges
- Nothing in particular
- Other: _____

(Optional) Comments

Your answer _____

Prediction of CV Risk Factors from Retinal Images

R. Poplin et al. (2018)

Prediction of individual risk factors

Predicted risk factor	Algorithm performance
Age (MAE)	3.26 (3.22,3.31)
Gender (AUC)	0.97 (0.966,0.971)*
Smoking status (AUC)	0.71 (0.70,0.73)*
Systolic BP (MAE)	11.35 (11.18,11.51)
Diastolic BP (MAE)	6.42 (6.33,6.52)
BMI (MAE)	3.29 (3.24,3.34)

Prediction of major adverse cardiac event

Model used	AUC (95% CI)
Algorithm only	0.70 (0.65,0.74)
Algorithm + risk factors	0.73 (0.69,0.77)
SCORE model	0.72 (0.67,0.76)

- ⦿ Algorithm achieves comparable results to European SCORE risk model



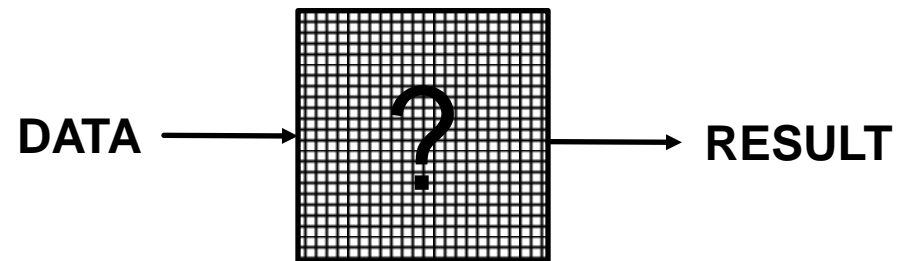
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“By far, the greatest danger of Artificial Intelligence is that people conclude too early that they understand it.”

- Eliezer Yudkowsky, Machine Intelligence Research Institute

The “Black Box” Problem

- ◎ Clinicians are unable to access the mechanisms of how machine learning makes its decisions
- ◎ Leads to a lack of trust and hesitation by clinicians



Danger of Distributional Shift

- ◎ An algorithm trained on particular sets of data might only be accurate for those datasets
- ◎ Machine needs to understand uncertainty, instead of blindly applying its algorithms to new data



Summary

- ◎ Machine learning: a powerful tool when used properly
- ◎ Capable of solving problems that humans by themselves cannot
- ◎ Caution must be taken when developing these algorithms



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“Just as the assembly line became the model for manufacturing, machine learning will become the model for data analysis and decision making.”

- Rob Thomas, IBM Analytics