What we need from AI in clinical practice

Tom Eelbode
Content

- AI vs Deep Learning
- What can Deep Learning do?
- What can Deep Learning do for colonoscopy?
- Examples
- Current limitations
What is AI?

Artificial Intelligence (AI)
Intelligence demonstrated by machines

Machine Learning (ML)
Machines learn from data

Deep learning (DL)
Machines learn from data and discover features automatically
What can Deep Learning do?
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• Classification/localization/detection/segmentation

Single object
CAT
CAT

Multiple objects
CAT, DOG, DUCK
CAT, DOG, DUCK

What can Deep Learning do?

- Classification/localization/detection/segmentation
- Regression
What can Deep Learning do?

- Classification/localization/detection/segmentation
- Regression
- Image-to-image

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- …
What can Deep Learning do for colonoscopy?
What can Deep Learning do for colonoscopy?

- Lesion detection/localization/segmentation
- Lesion characterization
- Lesion size assessment
- Quality assessment of procedure
- Blind spot detection / maximize surface area covered
- Write quantitative clinical report
- …
Some examples
Polyp detection/localization/segmentation

Polyp characterization

Polyp size measurement

![Polyp size measurement diagram](image)

Size (mm) 6
Quality measurement

• Automatic detection of Cecum => cecal intubation rate & withdrawal time

Blind spot detection

- Detect missed colonic surface by 3D reconstruction
CRC Screening colonoscopy report

Patient details
Patient: Homer Simpson
Sex: Male
Date of birth: April 19, 1987

Procedure details
Doctor: Dr. Nicholas Riviera M.D.
Date of procedure: October 18, 2019
Duration: 00h14m15s
Bowel preparation: 4/5
Surface area covered: 92%

Summary
The pullback time from cecum to anus was 14 minutes and the bowel preparation was performed well. Two polyps were found: one hyperplastic which was left in-situ and another tubular adenoma with low-grade dysplasia which was removed with hot snare. No significant bleeding was seen and there seemed to me minor inflammation in the rectum.

Findings
Cecum
Polyp #1
Location: Ascending colon, 65cm
Size: 6mm
Type: Hyperplastic (87% confidence)
Removal technique: N/a

Polyp #2
Location: Transverse colon, 38cm
Size: 27mm
Type: Tubular adenoma, Low-grade dysplasia (92% confidence)
Removal technique: Hot snare
Limitations
What is still missing?

• Realistic, large multi-center video dataset collection from different endoscope types, modalities, operators, patients,… with histological ground truth
• Make sure quality of data does not decrease due to quantity increase
• Convenience of use should go up
• Combine multiple systems (e.g. detection+characterization+clinical report)
• External validation mentality
• Unified benchmark by independent organization?
• Clinical validation outside academic setting
• Fix fundamental technical issues (e.g. explicable results, well-calibrated confidence outputs, long-term time dependencies, overfitting,…)
• Impact of AI tools on doctor’s behavior?
• Training for doctors to use AI tools?
• Legal and ethical issues?
Let’s fix these together!