

# AI for breast imaging

Are the robots coming, or are they already here?



**Ioannis Sechopoulos**

Advanced X-ray Tomographic Imaging (AXTI) Lab  
Department of Radiology and Nuclear Medicine  
Radboud University Medical Center  
and  
Dutch Expert Center for Screening (LRCB)

ioannis.sechopoulos  
@radboudumc.nl



axti.radboudimaging.nl



@IoannisNL



**Radboudumc**

---

***“Radiologists who do AI will  
replace radiologists who don't”***

*- A certain Dutch radiologist  
(...and many others)*

---

# Disclosures

Research Agreements: Siemens Healthcare  
Canon Medical Systems

Speaking Agreements: Siemens Healthcare  
Hologic

ScreenPoint Medical is a spin-off company from my Department. I have no financial relationship with ScreenPoint.

---

## AXTI Lab

(Advanced X-ray  
Tomographic Imaging)

Ritse Mann

Alejandro Rodriguez-Ruiz  
Nico Karssemeijer



---

# AI for Breast Imaging

How good are they?

Faster!

Better!

Less!

---

# Why now?

---

# Running out of screening radiologists

---

# DBT takes time



# False negatives

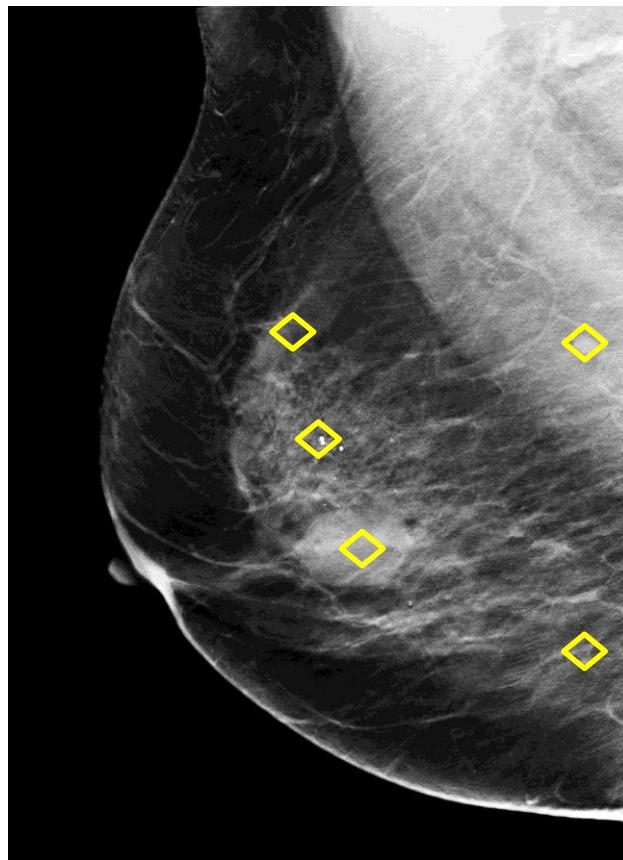
	DBT/DM positive	DBT/DM negative
DM positive	35	0
DM negative	20	10

# False negatives

	Tomo + Mammo -	Tomo - Mammo +
Visibility	13	0
Radiographic appearance	3	1
Interpretative error	3	6



**Confessions of a  
SLIGHTLY NEUROTIC  
HITWOMAN  
JB LYNN**

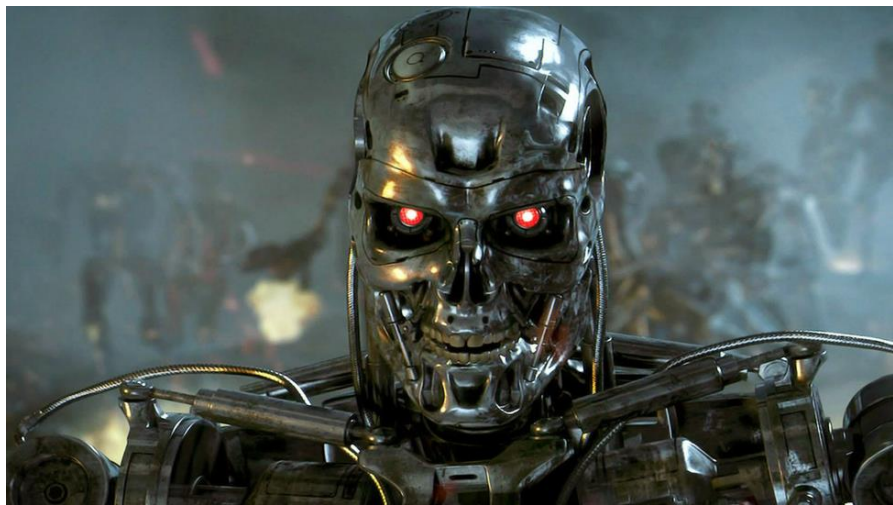


---

# How good is it?

---

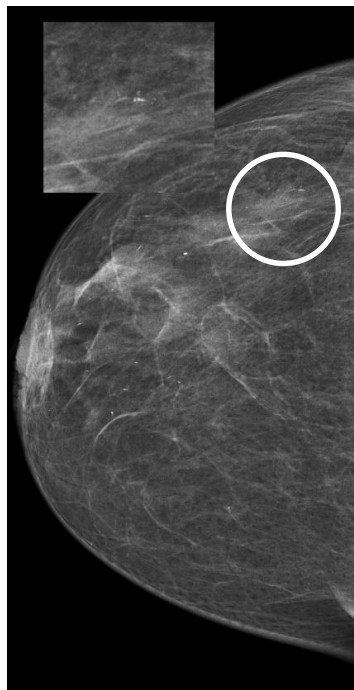
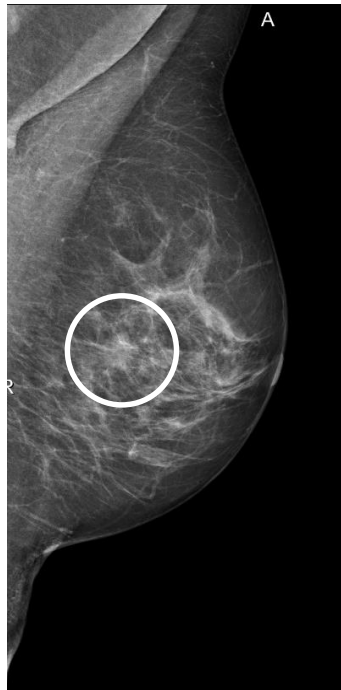
# AI system



# Breast screening radiologists



# Task: detect breast cancer in mammography



Case  
level

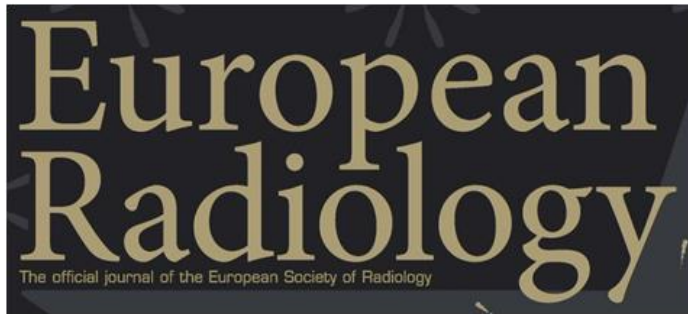
---

# Digital Mammography Cases

---

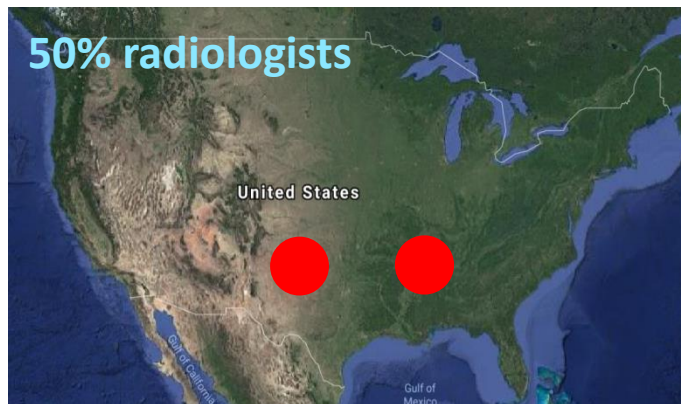
# 9 Previous multi-reader multi-case retrospective studies

Radiology

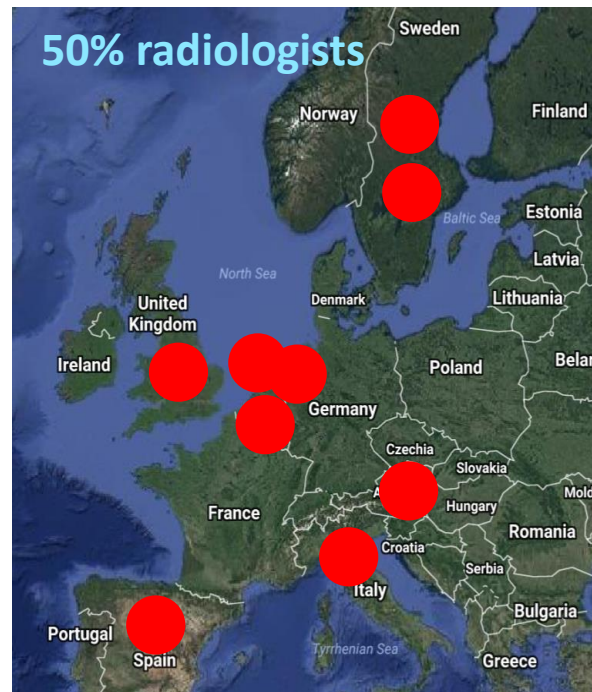




# Datasets



Varied datasets characteristics & sizes  
Different radiologists



---

# Breast screening radiologists

Varied experience  
with screening:  
1-45 years  
avg. 10 years



---

# Total numbers

**2,652 exams**

653 malignant (i.e. enriched sets)

50% screening/50% diagnostic

---

# Total numbers

# 101 radiologists



---

# Total numbers

**28,296 independent interpretations**

---

# Total numbers

## 4 vendors

GE

Hologic

Philips

Siemens

---

# AI SYSTEM

---

# AI system

Transpara 1.4.0

(ScreenPoint Medical, Nijmegen, the Netherlands)

Based on deep learning algorithms



---

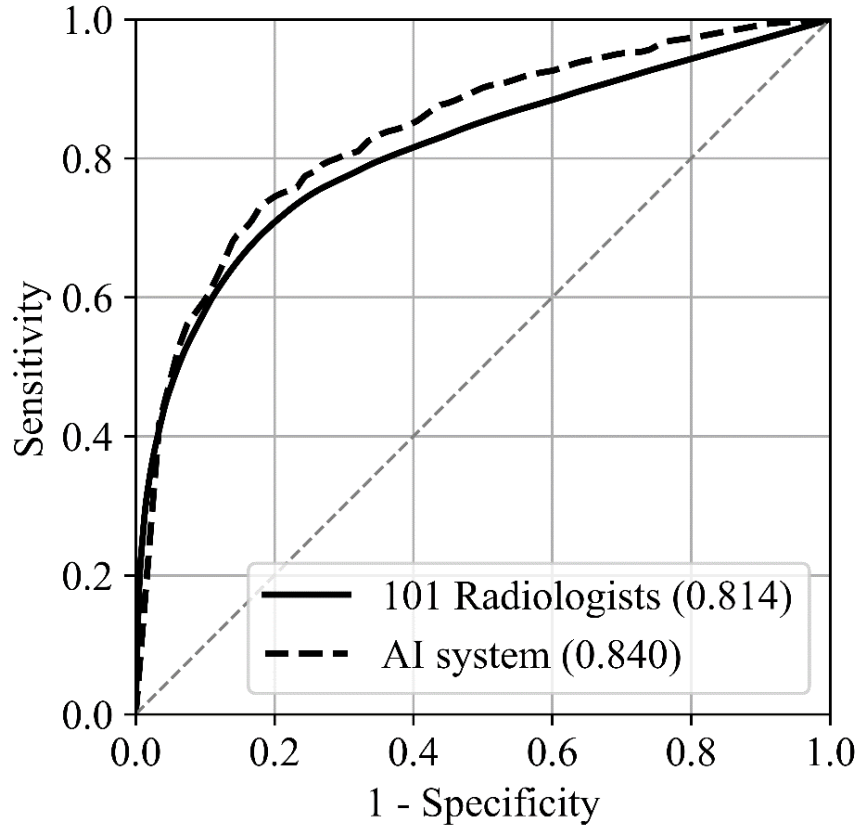
# Statistical analysis

Non-inferiority hypothesis in terms of  
area under the ROC curve (AUC)

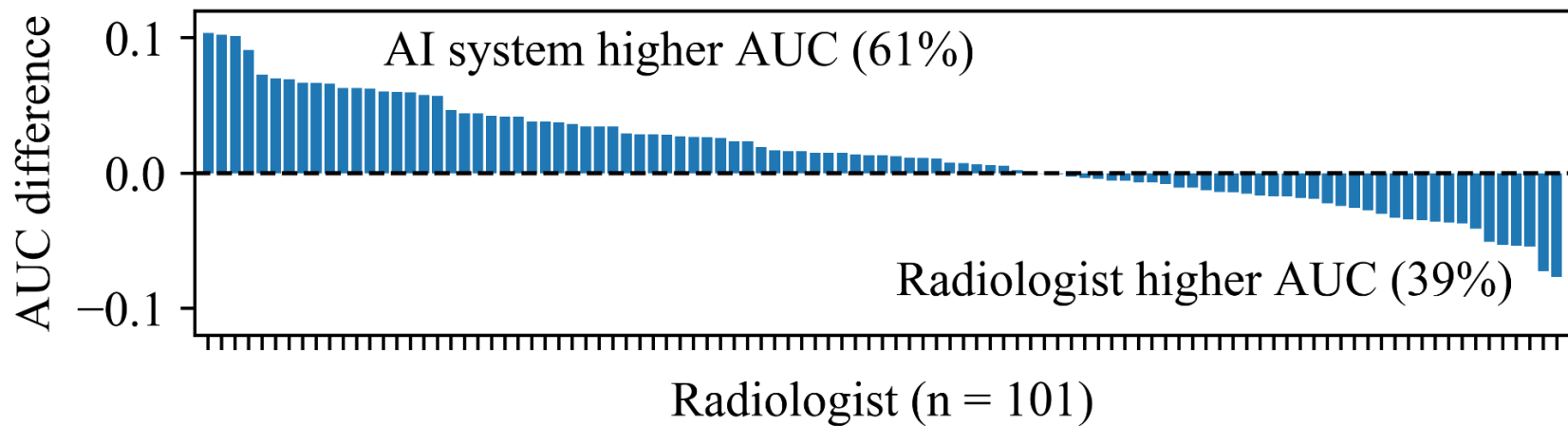
Margin 0.05

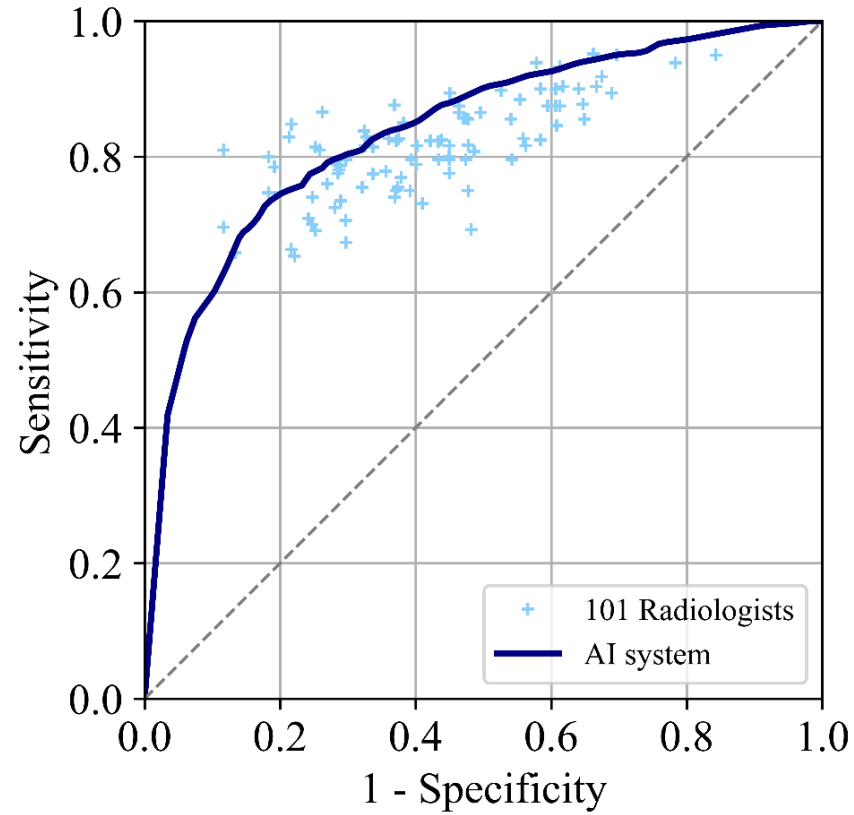
---

# RESULTS

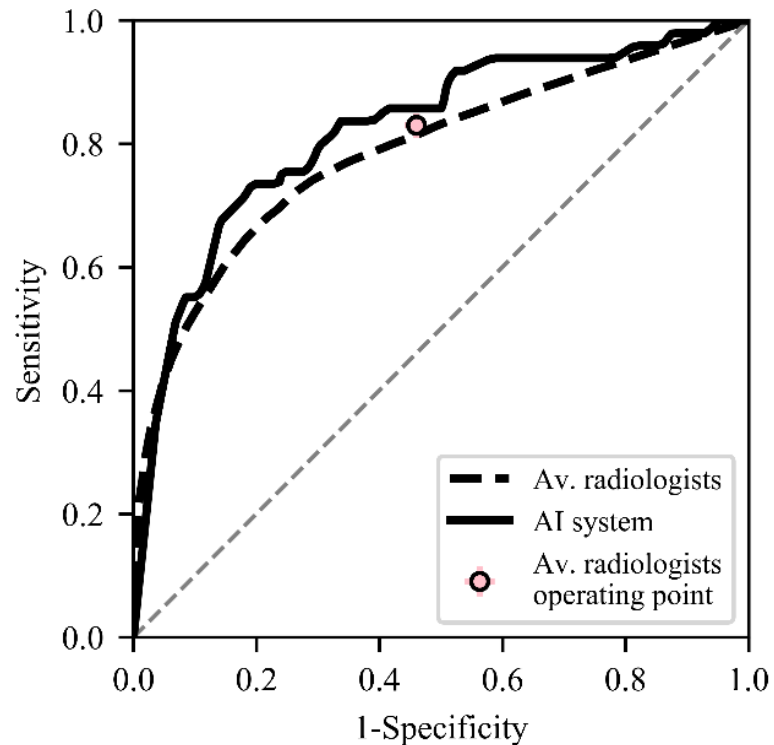
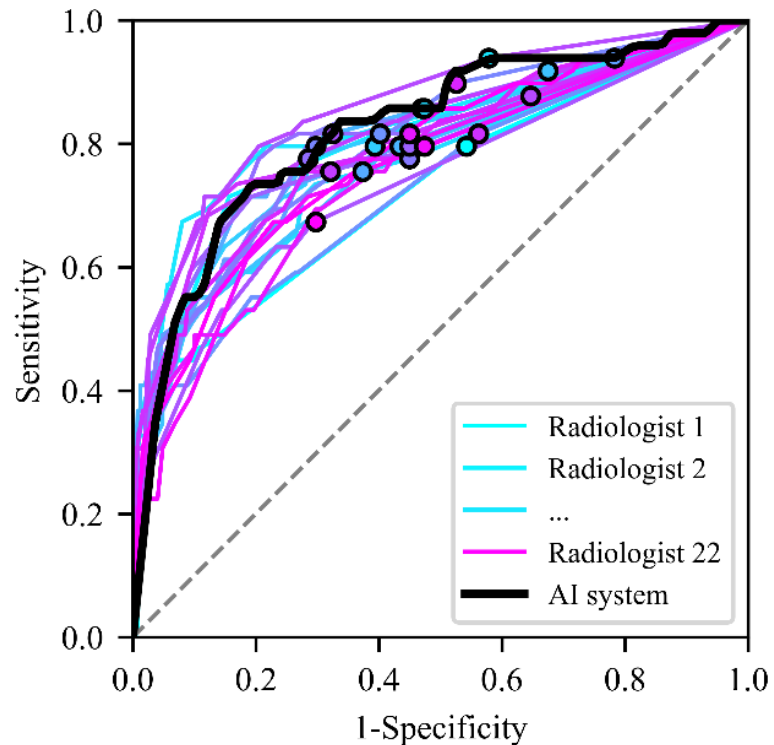


**0.814 vs. 0.840**  
**+0.026**  
**95% CI: -0.003, +0.055**





## Dataset E1



---

# Limitations

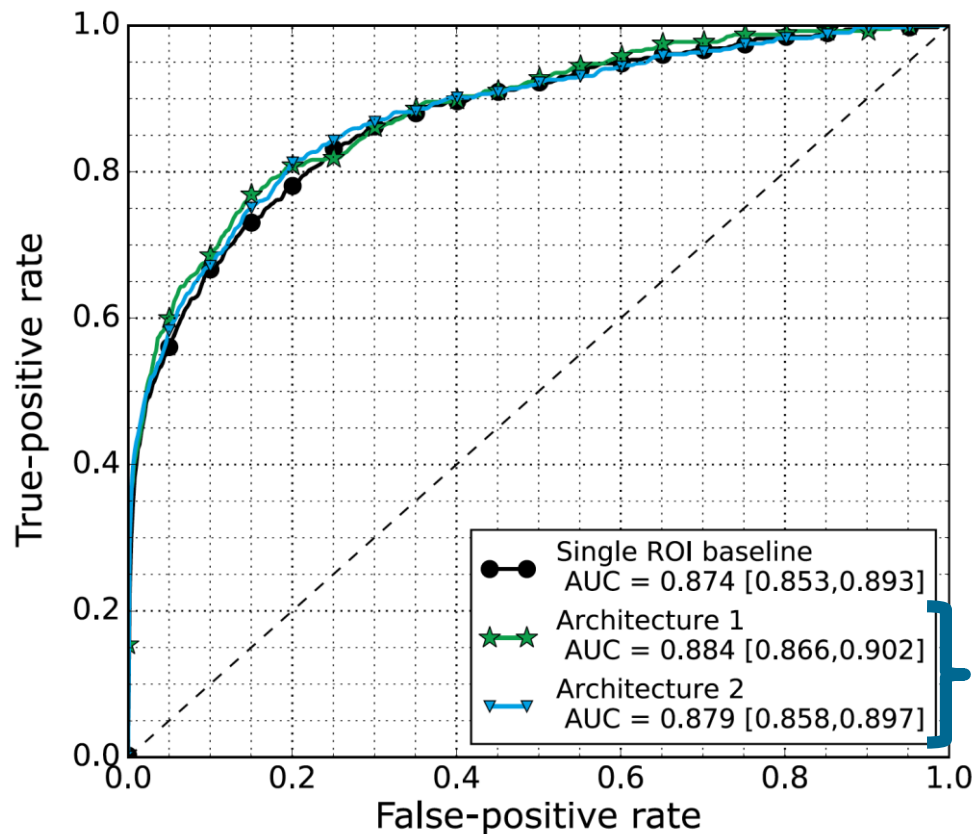
Not all datasets were  
bilateral and with priors

---

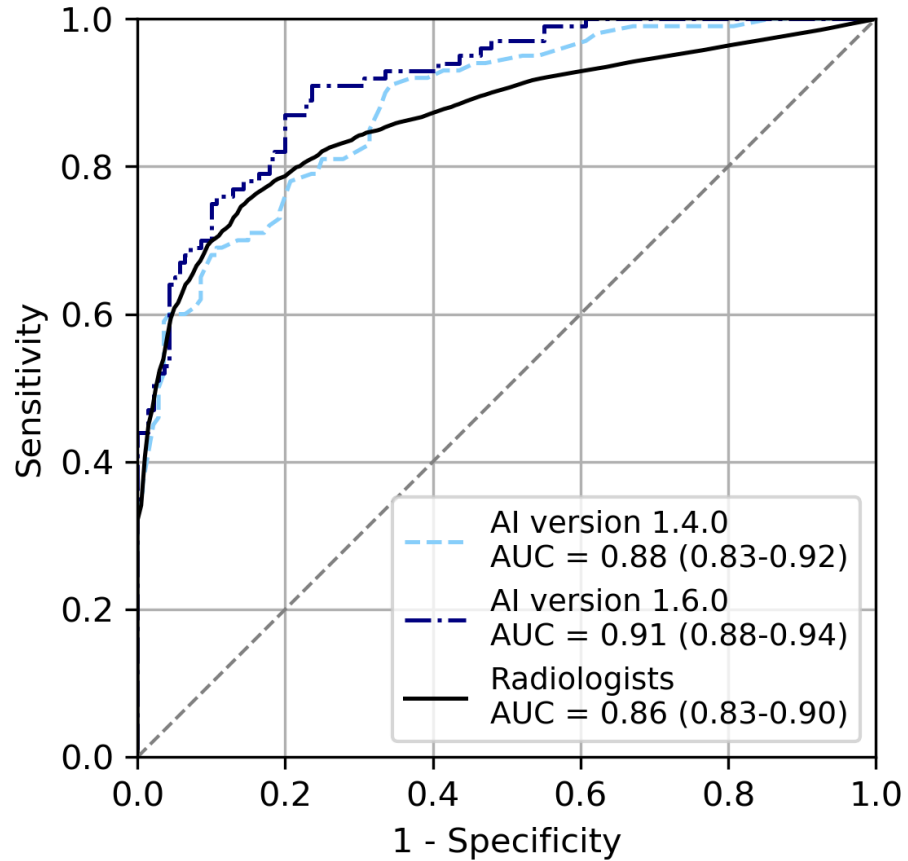
**AI doesn't consider  
priors...**

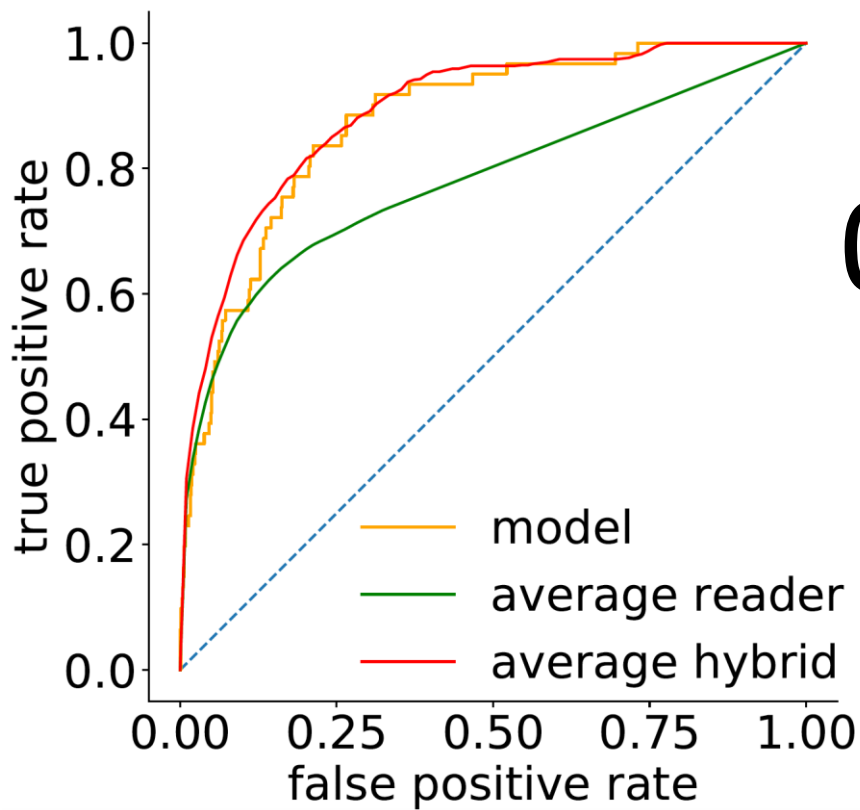
**...but...**





with prior  
analysis





0.778 vs. 0.876  
+0.098

---

# AI for DBT vs. Radiologists

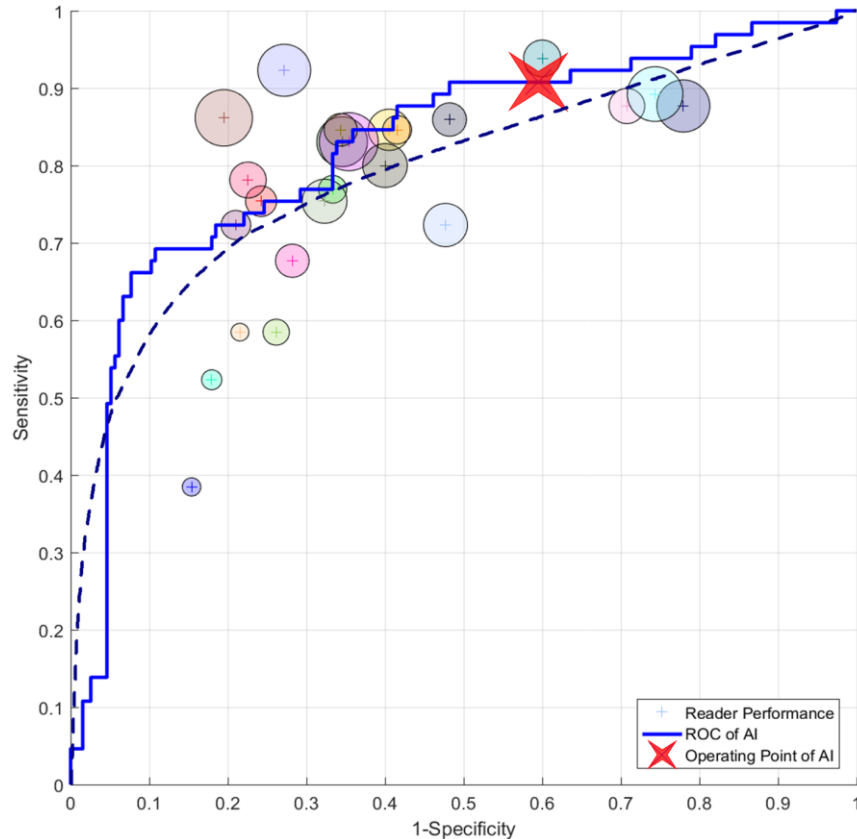
260 cases

65 cancer cases

24 MQSA radiologists

13 breast rads

PowerLook Tomo Detection 2.0 (iCAD)



Avg. of radiologists:  
 sensitivity: 77.0%  
 specificity: 62.7%

AI system:  
 sensitivity: 91%  
 specificity: 41%

---

# Enriched data sets

# Retrospective reads

---

**We're on our way...**

**...to where?**

# Faster!



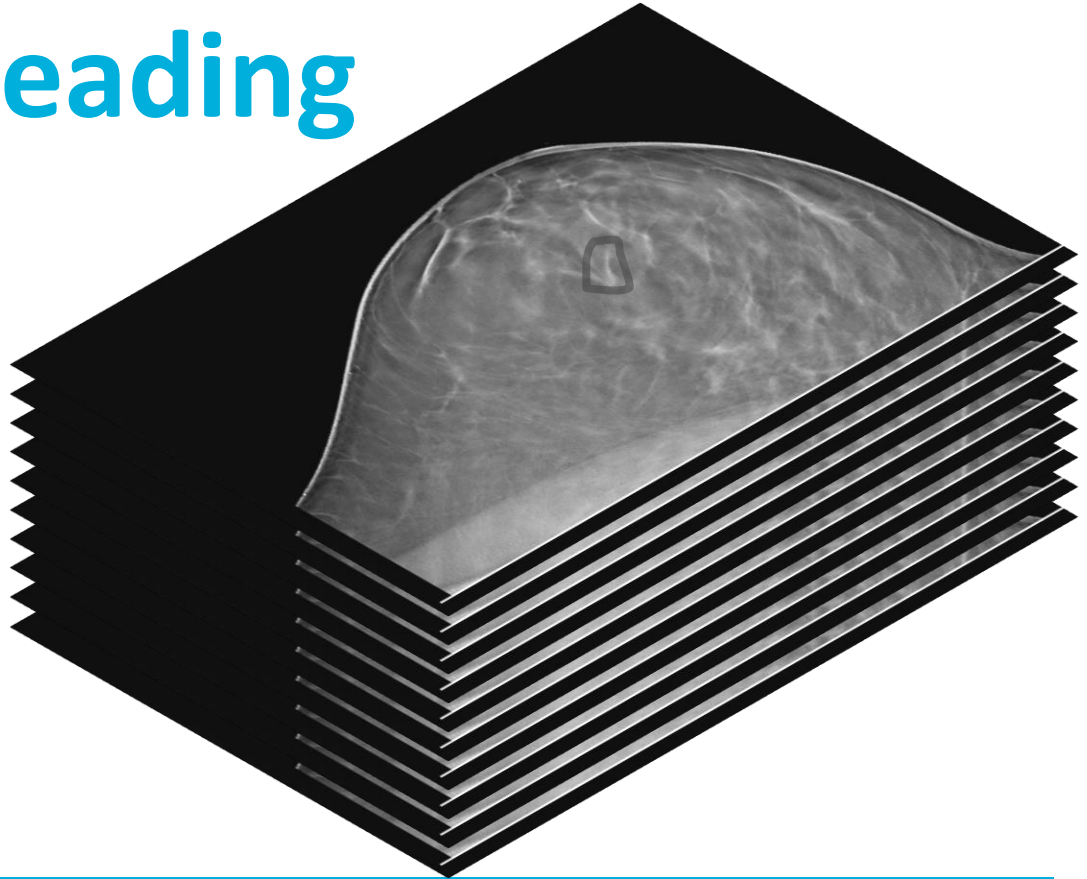


---

$$RT(DBT) = 2.0 * RT(DM)$$

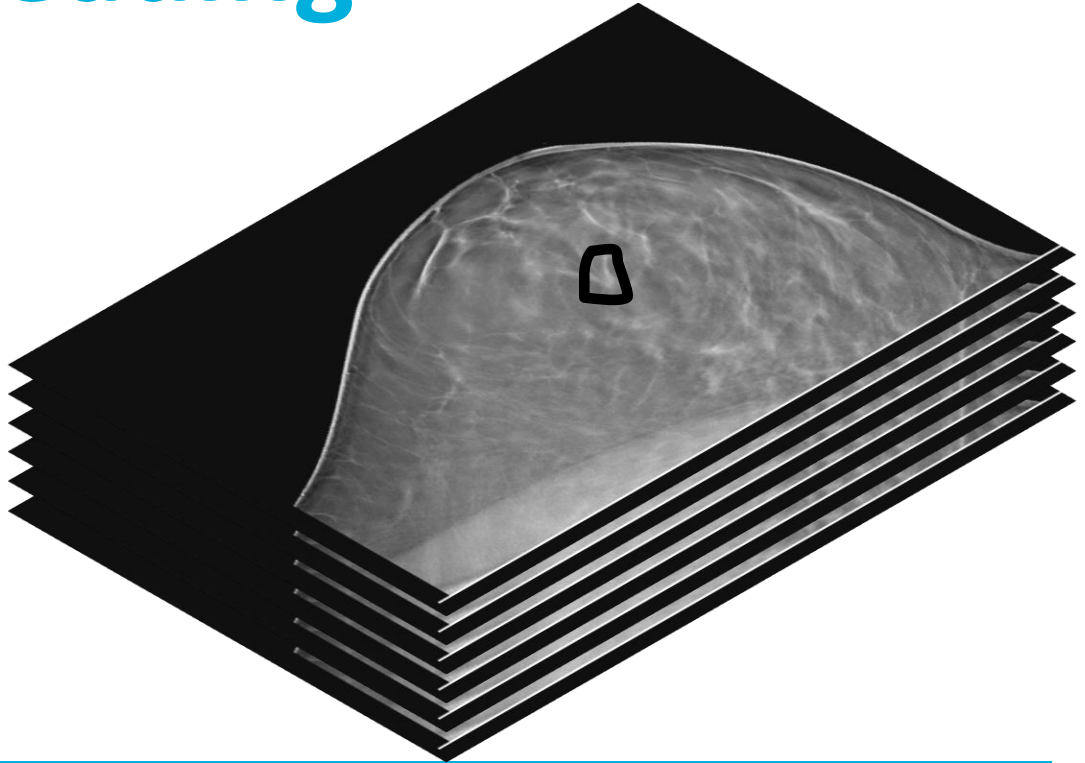
---

# AI-assisted reading



---

# AI-assisted reading

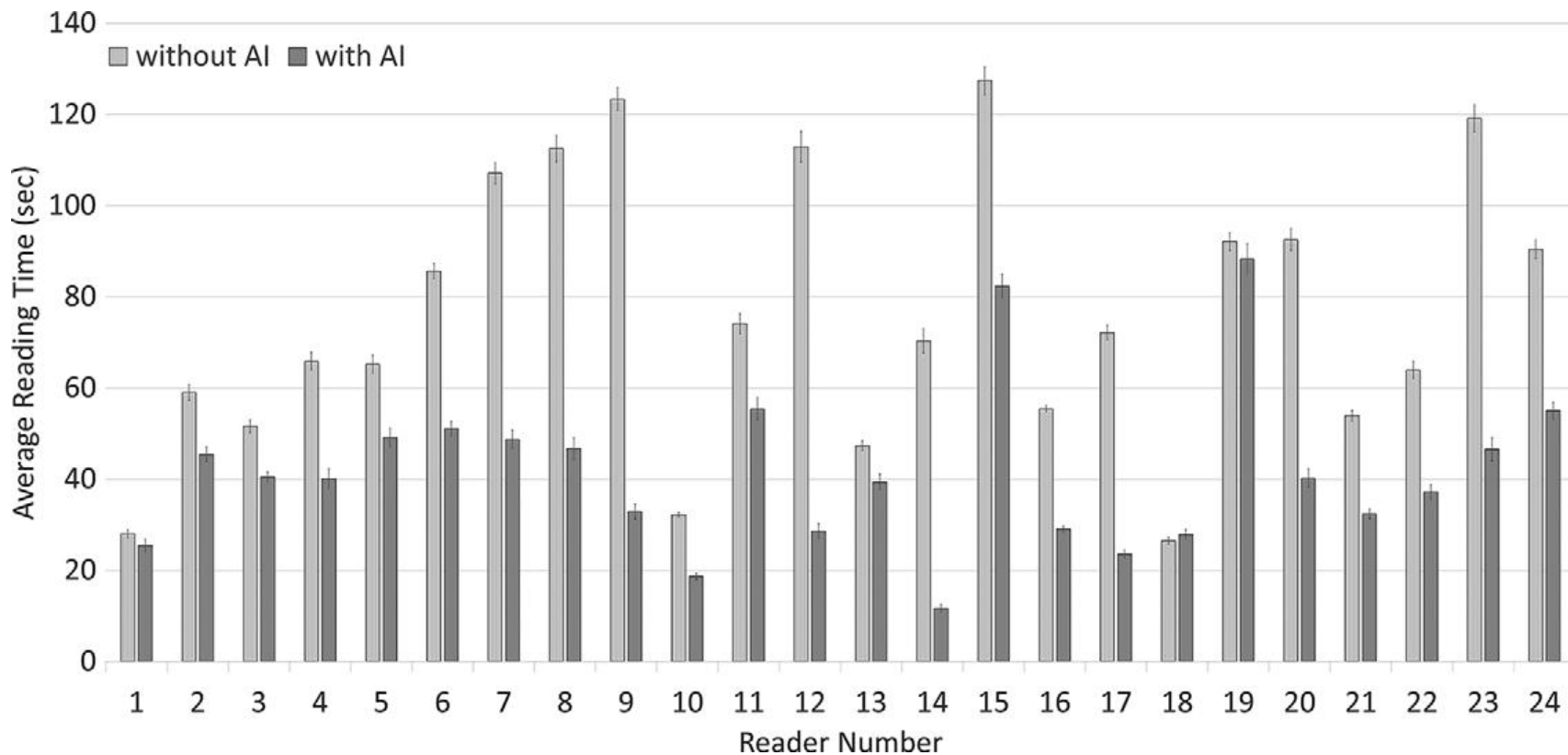


---

# Reading time reduction

64.1 s → 30.4 s

-52.7%\*



---

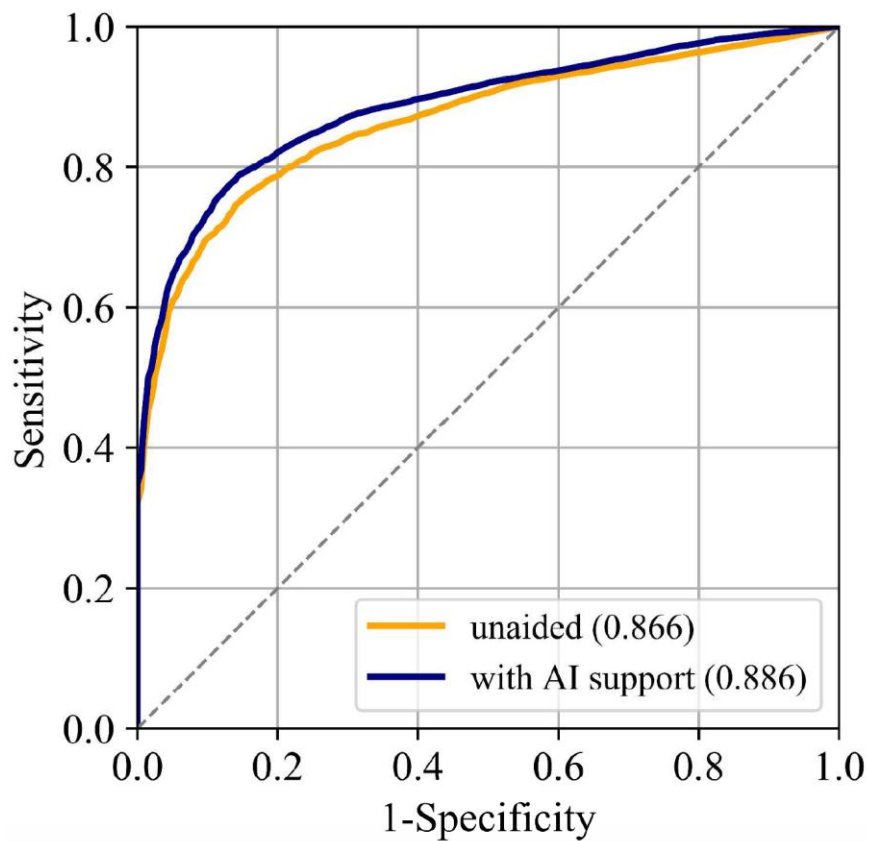
# AI-assisted rad reading

# OR

# rad-assisted AI reading?

---

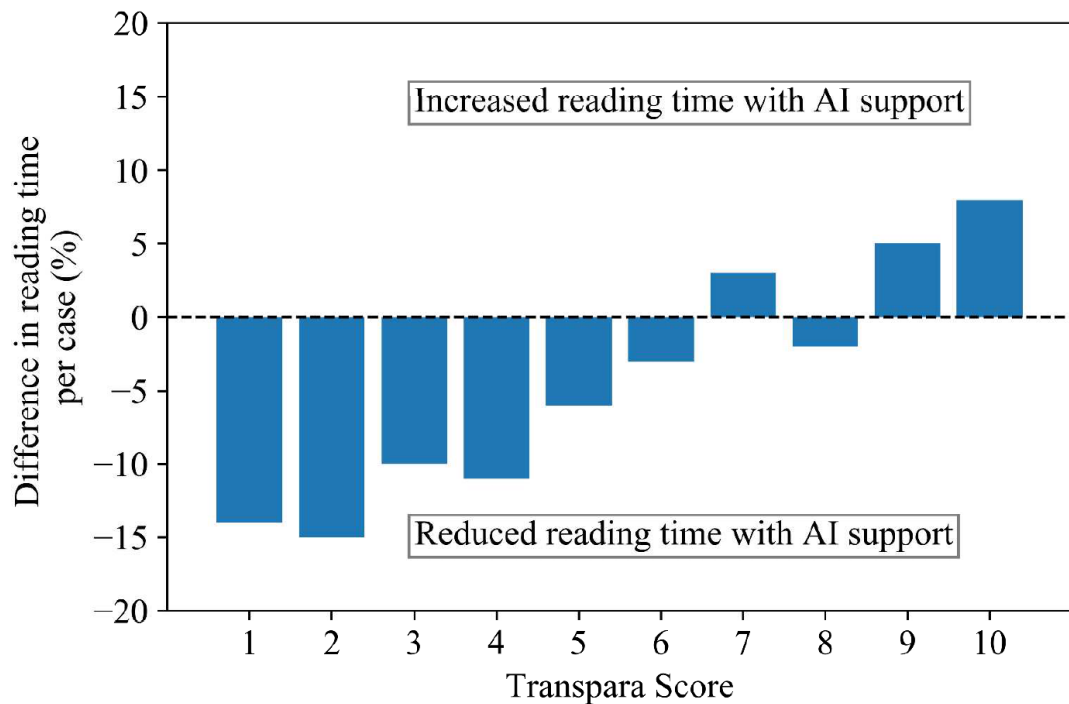
# Better!



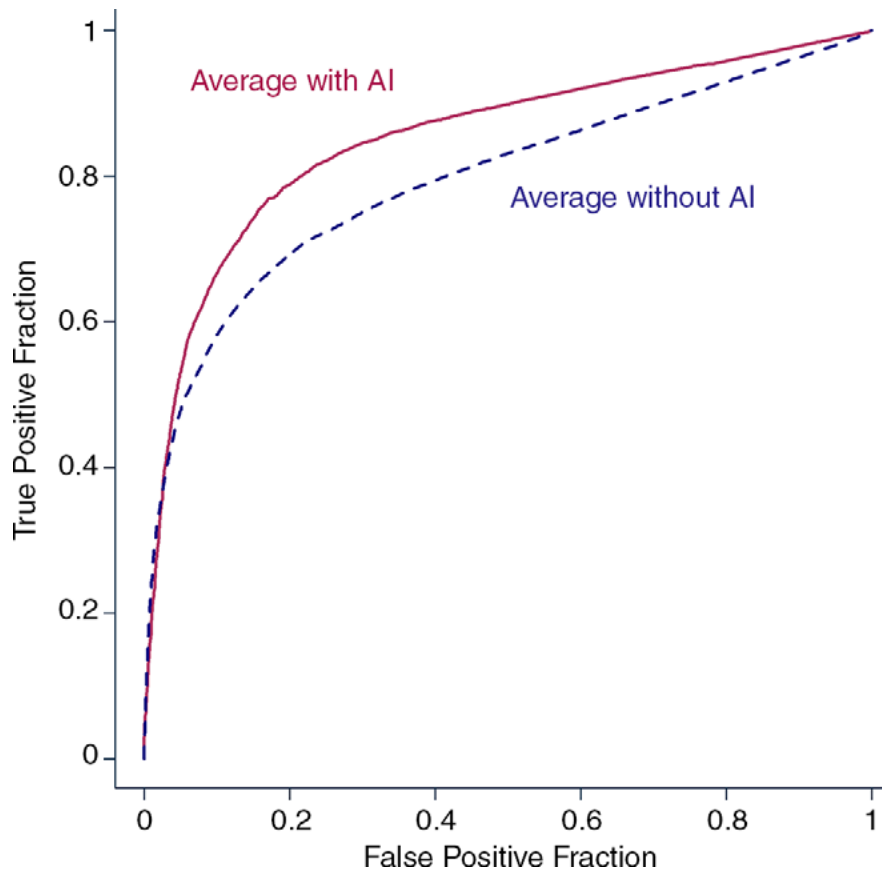
DM:  
0.866 [0.83,0.90]  
➔ 0.886 [0.85,0.92]

+0.020  
[0.007, 0.032]  
P = 0.002





Unaided: 146 s  
w/ AI: 149 s  
P=0.15



DBT:  
53% reduction:

0.795 → 0.852  
+0.057\*

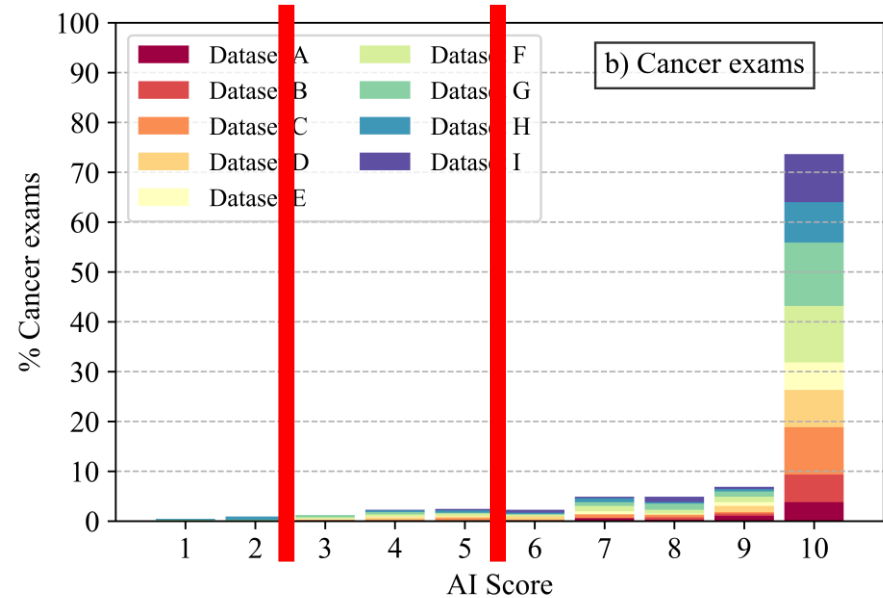
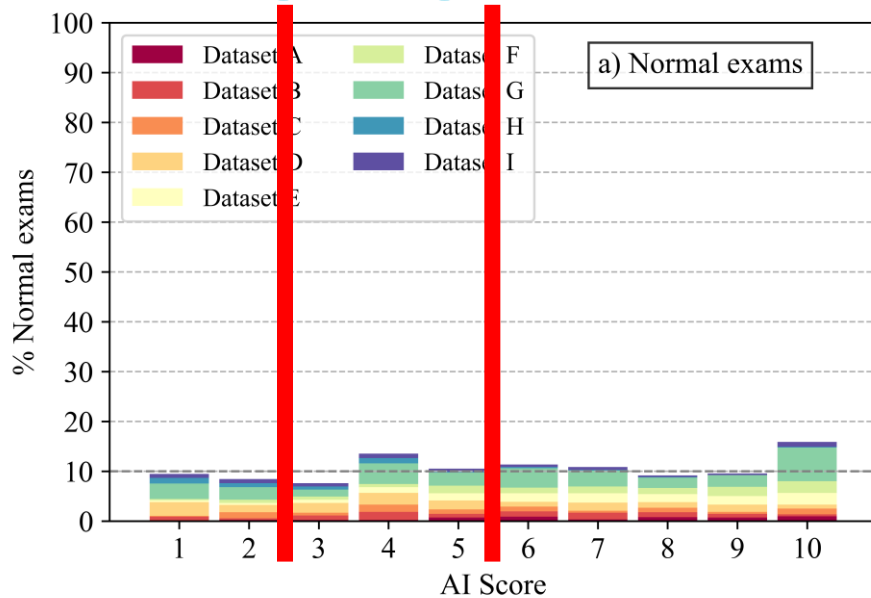
---

# Less!

---

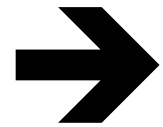
# AI Assisted Reading vs. Standalone AI

# Triaging AI



---

47% decrease in cases

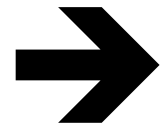


-7% cancers

-27% false positives

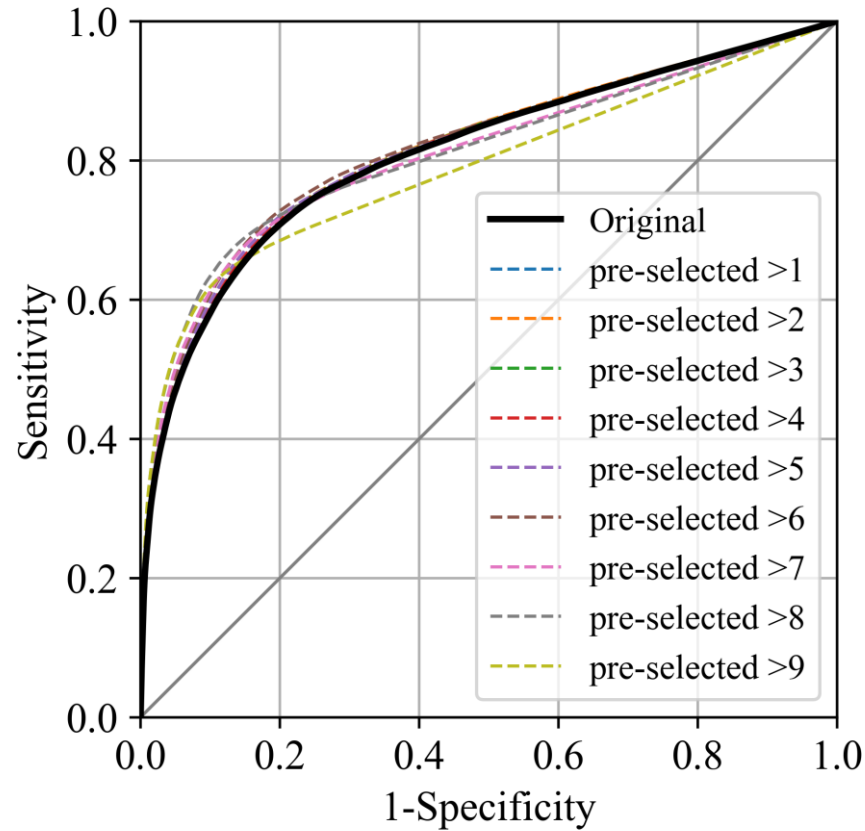
---

20% decrease in cases



-1% cancers

-5% false positives





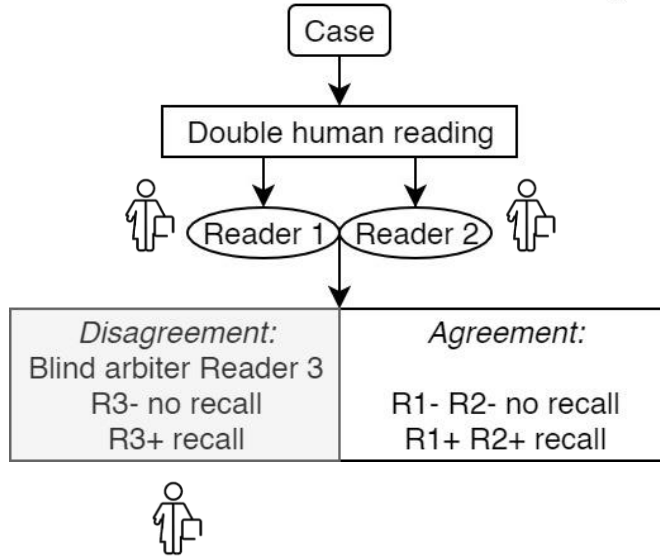
---

All 8 missed  
cancers were  
“clearly visible”

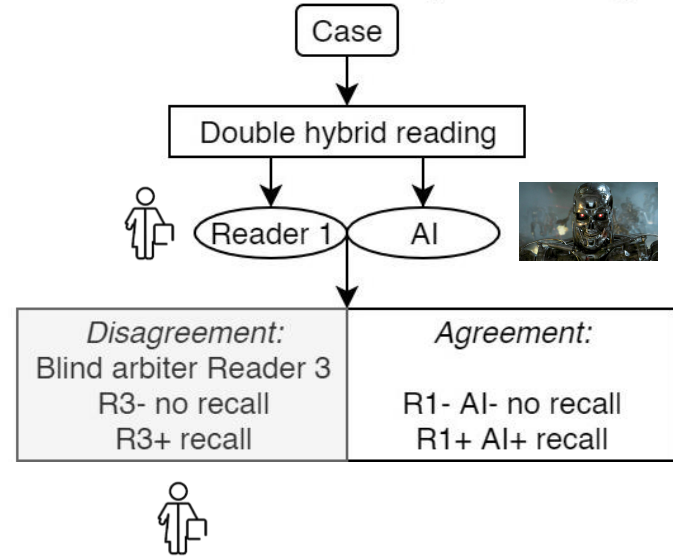




### Scenario 1 - Double Human Reading



### Scenario 2 - Double Hybrid Reading





Double **Human** Reading

Double **Hybrid** Reading

Difference

**Sensitivity (%)**

81.5  
(75.8, 87.3)

81.4

(75.3, 87.2)

-0.1

(-4.1, 3.9)

P = 0.88

**Specificity (%)**

69.9  
(68.4, 71.5)

75.2

(73.8, 76.7)

+5.3

(4.0, 6.7)

P<0.001



Double **Human** Reading

Double **Hybrid** Reading

Difference

**Workload (%)**

100

56  
(55, 57)

-44  
(-42, -45)  
P<0.001

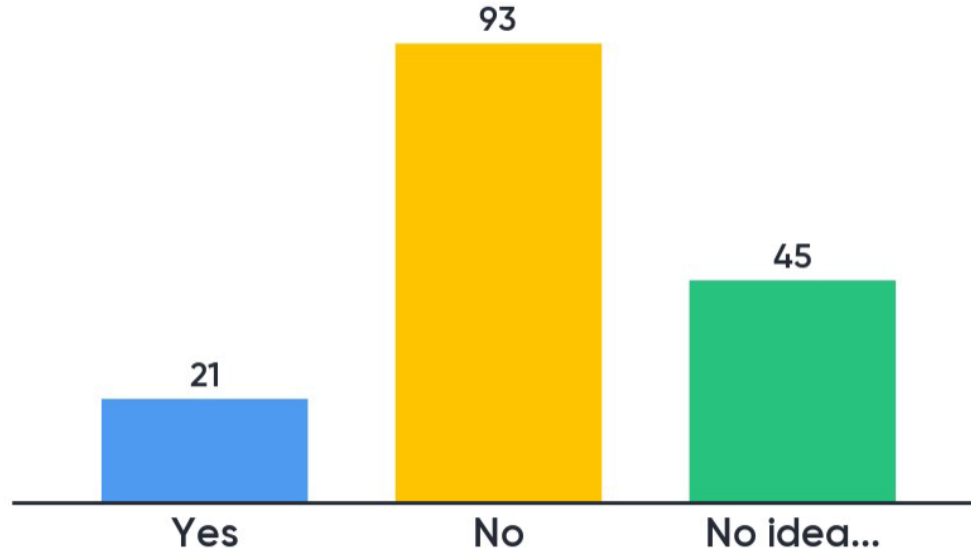
---

# Which cancers?

---

# How will radiologists behave?

# Will you read the same way after AI triaging?



159



---

# AI for breast image interpretation

---

# Better?

“lab” results say yes

need for prospective  
screening-prevalence trials

---

# Faster?

yes!

is rad-assisted AI reading  
acceptable?

---

# Less?

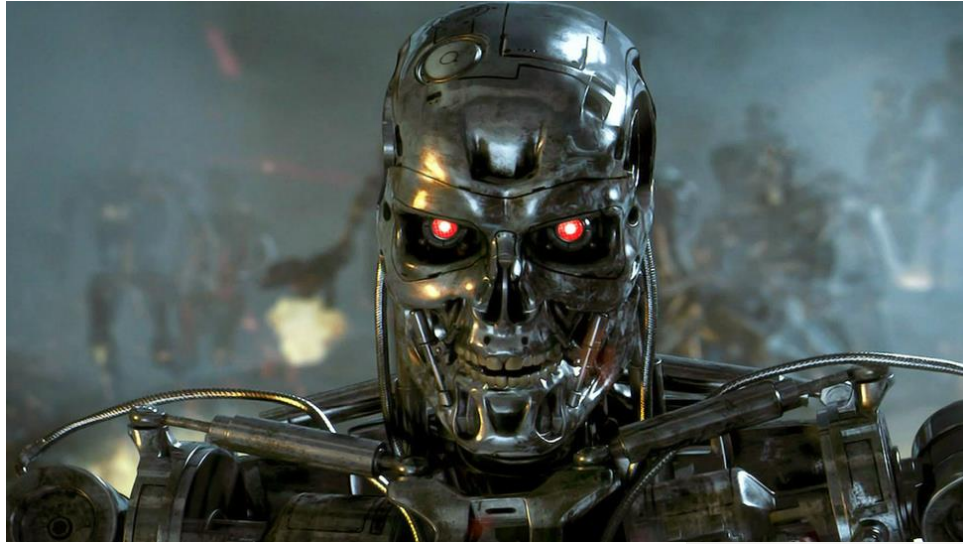
triaging  
single human reading  
other...

promising results, more needed

---

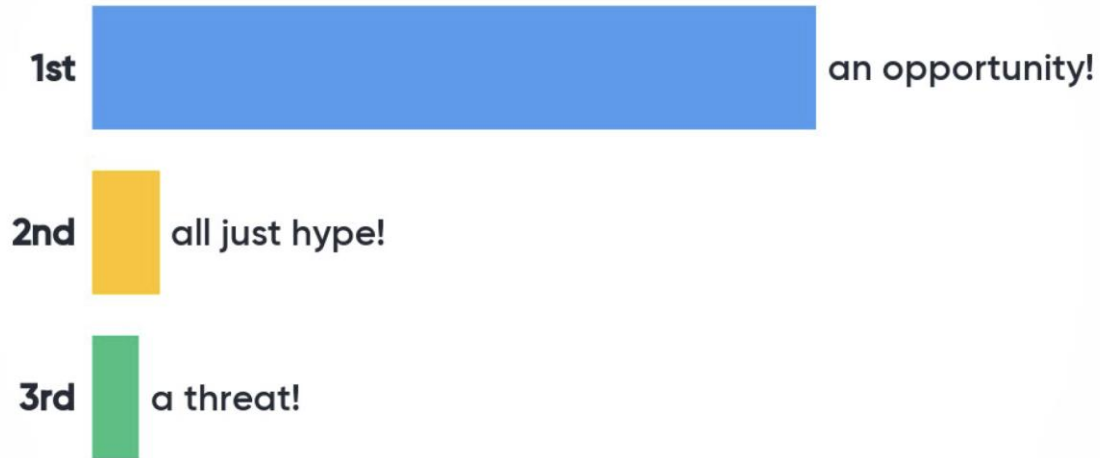
# Our role...

Even with commercial software,  
**WE** are the scientists to  
determine/prove the role of AI in  
clinical breast imaging!



# AI for DM/DBT is....

Mentimeter



116

# Thank you for your attention!

(hopefully you weren't checking your emails all this time...)

ioannis.sechopoulos  
@radboudumc.nl



axti.radboudimaging.nl



@IoannisNL



Radboudumc