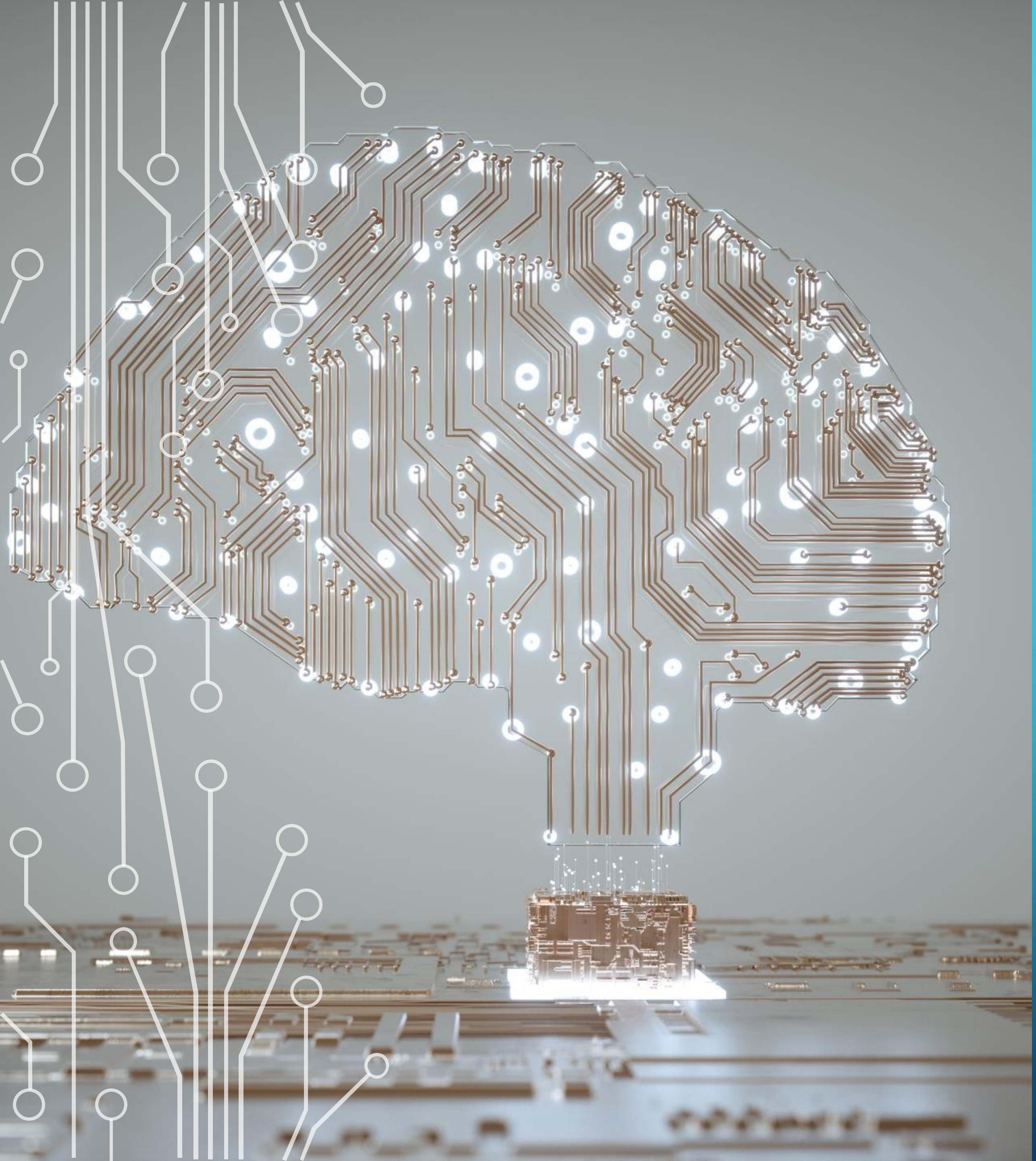


INTELLIGENZA ARTIFICIALE IN SENOLOGIA

DR. PAOLO CABASSA

RADIOLOGIA BONVICINI

BOLZANO

SOMMARIO

1 DIGITAL HEALTH

2 INTELLIGENZA ARTIFICIALE

3 INTELLIGENZA ARTIFICIALE IN RADIOLOGIA

4 INTELLIGENZA ARTIFICIALE IN SENOLOGIA

CASI CLINICI


Intelligenza artificiale
Usi quotidiani e usi possibili
Alcuni esempi di come viene usata l'IA e delle possibilità che offre
Assistenti personali digitali nei computer e negli smartphone
Motori di ricerca
Traduzione automatica
Cyber-sicurezza
Lotta alla disinformazione
Ottimizzazione prodotti e catene di vendita
Aria condizionata intelligente
Veicoli a guida autonoma
Shopping e pubblicità in rete
Internet delle cose: ad esempio aspirapolveri, frigoriferi e orologi connessi
Agricoltura intelligente: robot per irrigare, diserbare, nutrire gli animali
Robot nelle fabbriche
europarl.eu

2017

Forbes

Digital Therapeutics: The Future of Health Care Will Be App-Based

The Economist — A new sort of health app can do the job of drugs

MIT Technology Review — Rewriting Life

Can "Digital Therapeutics" Be as Good as Drugs?

The New York Times — Take This App and Call Me in the Morning

A new category of prescription medical treatments, what executives call digital therapeutics, comes in the form of mobile apps.

OGGI

«La Digital health è arrivata ed è destinata a rimanere»

- La disponibilità e la crescente diffusione della Digital Health e delle DTx stanno determinando un cambio di paradigma nei percorsi di cura, e anche l'atteggiamento di molti operatori sanitari nei confronti della salute digitale sta evolvendo.
- La domanda non è più «Abbiamo bisogno della Digital Health?», ma piuttosto «Come possiamo adattare il nostro sistema sanitario per integrare al meglio la Digital Health?»

THE ERA OF
DIGITAL HEALTH

The era of digital health is upon us. It is fundamentally different from what has come before, with profound influences on health and healthcare.

What has come before

ICT in Health 1950s – 1960s

1st WAVE

- Mainframe computers
- Focus on corporate support functions such as accounting and payroll
- Applications were function driven
- Industry agnostic (not health specific)

Health ICT 1960s – 2000s

2nd WAVE

- Practice management systems
  Big integrated systems
  Best of breed systems
- Focus was the healthcare organisation
- Corporate applications for logistics and performance management
- Health service provider centric

E-Health 2000s – 2020

3rd WAVE

- Enterprise and system wide information flows begin
- Shared health records and health information exchanges
- Focus on whole of health system
  Health system centricity
- Patient following but still provider centric
- Governments as key players in and funders of e-health
- Healthcare as a process rather than health as an outcome
- Bulk of healthcare data provider-originated and controlled

THE FOURTH WAVE: DIGITAL HEALTH (2020+)

DIGITAL HEALTH = HEALTH AND HEALTHCARE IN THE DIGITAL SOCIETY

Digital Health is about HEALTH

The 4th wave
A great leap forward along the evolutionary path of ICT in healthcare

Tech
Enabled by exponential increases in the pervasion of ICT throughout society

Decentralised
With service providers as participants, not controllers

Citizen centric
Driven by citizens' demands that their health and wellbeing are controlled by them and expectations for digital service delivery embedded within their life patterns

Data, data everywhere
Harvests data in real time from sources within and outside of traditional health settings

Knowledge
Generated via sophisticated analytics

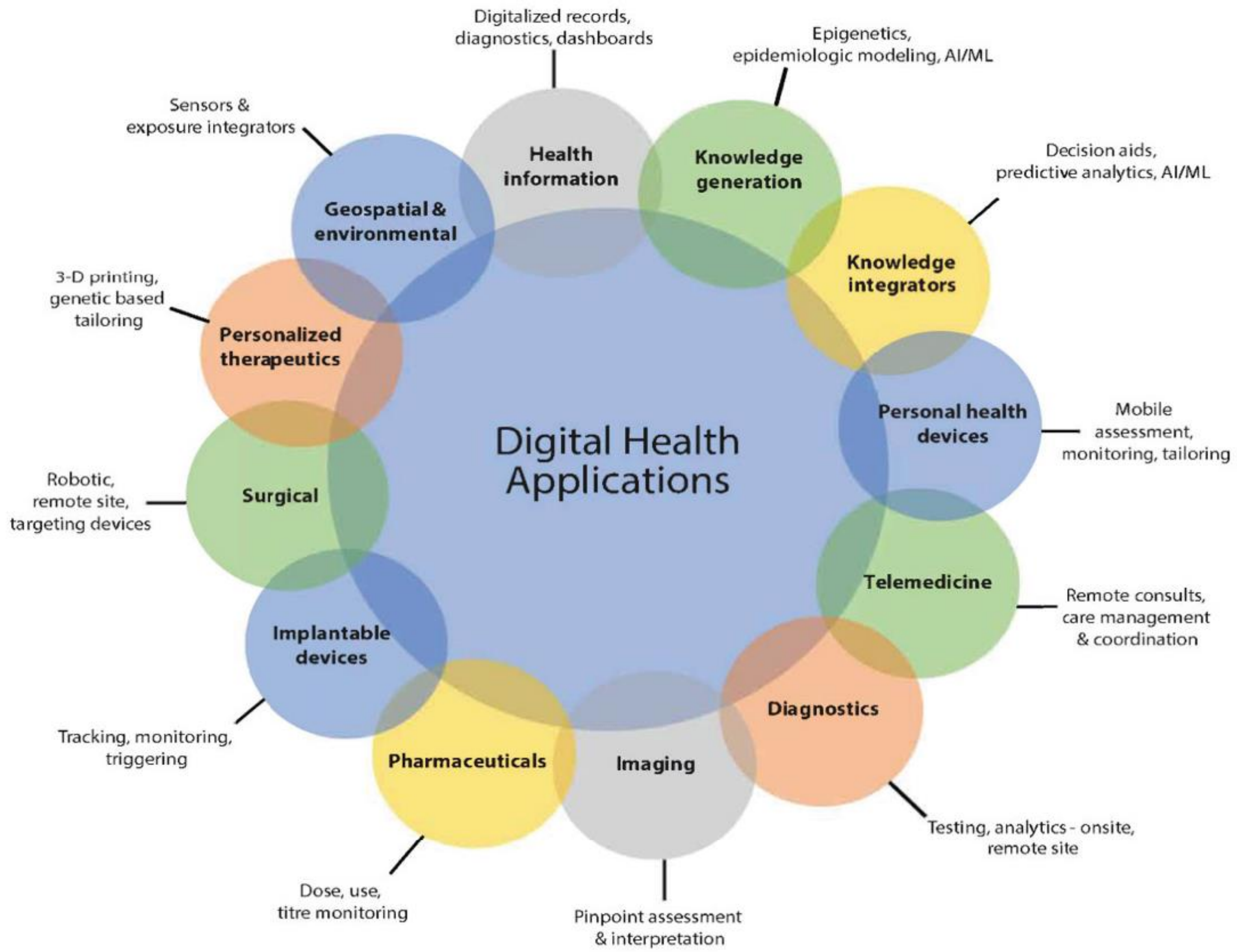
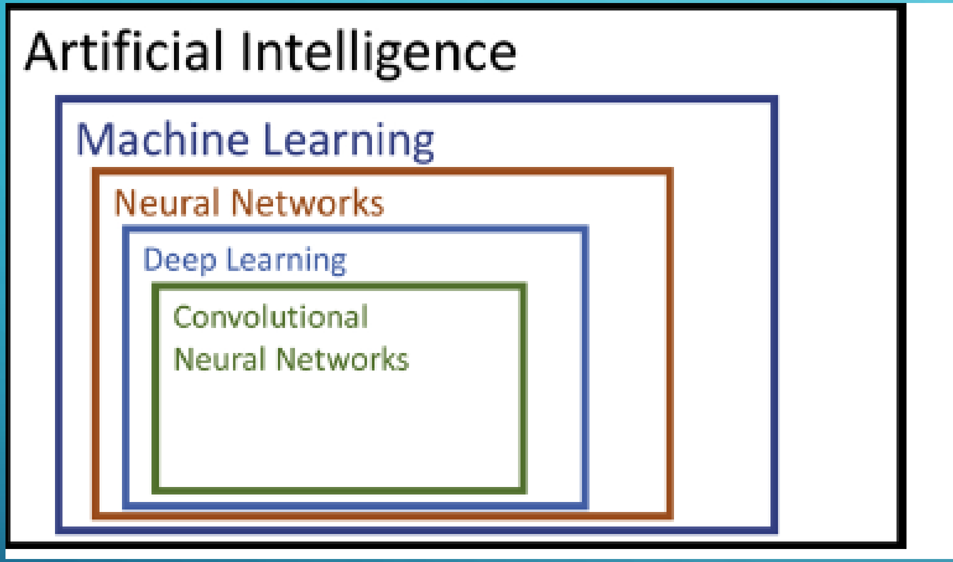


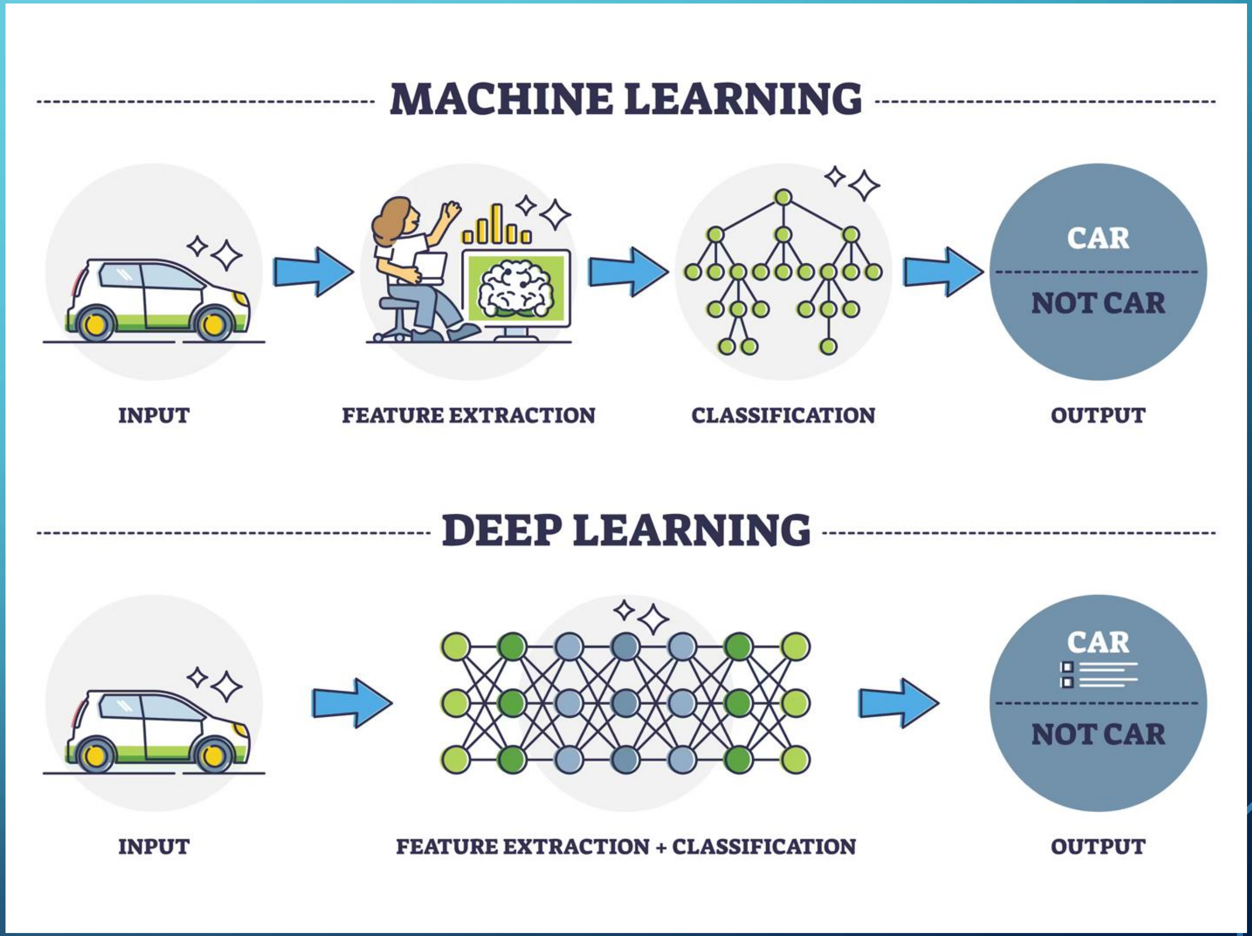
FIGURE 1 | Evolving Applications of Digital Technology in Health and Health Care
SOURCE: National Academy of Medicine. 2019. *Digital Health Action Collaborative, NAM Leadership Consortium: Collaboration for a Value & Science-Driven Health System.*

TRE TIPI DI INTELLIGENZA ARTIFICIALE

- Artificial Narrow Intelligence (ANI) chatbot, guida autonoma, SIRI, ALEXA…
- Artificial General Intelligence (AGI) =uomo
- Artificial Super Intelligence (ASI) superiore all’uomo

INTELLIGENZA ARTIFICIALE





PERCHÉ L'INTELLIGENZA ARTIFICIALE SPAVENTA?

1980

Luca, Manfred, Olena, Cathy, Hans

2024

Anna, Guido, Robert, Franz, Alessandro


StyleGAN2 di Nvidia

- Quindi siamo spaventati dalla possibilità di essere ingannati.. Specie se si tratti di salute

- Inoltre siamo influenzati da opinioni sui media e social che mostrano l’intelligenza artificiale come un alieno che entrerà nel nostro cervello

- Il pericolo... Attualmente… è meno grave di quello che si pensa

- Si tende ad antropomorfizzare l’intelligenza artificiale che tanto intelligente poi non è .

RODUTTIVA

Transmission Versus Truth, Imitation Versus Innovation: What Children Can Do That Large Language and Language-and-Vision Models Cannot (Yet)

Eunice Yiu, Eliza Kosoy, and Alison Gopnik
Department of Psychology, University of California, Berkeley

Perspectives on Psychological Science
1–10

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sagepub.com/journals-permissions
DOI: 10.1177/17456916231201401
www.psychologicalscience.org/PPS
Sage

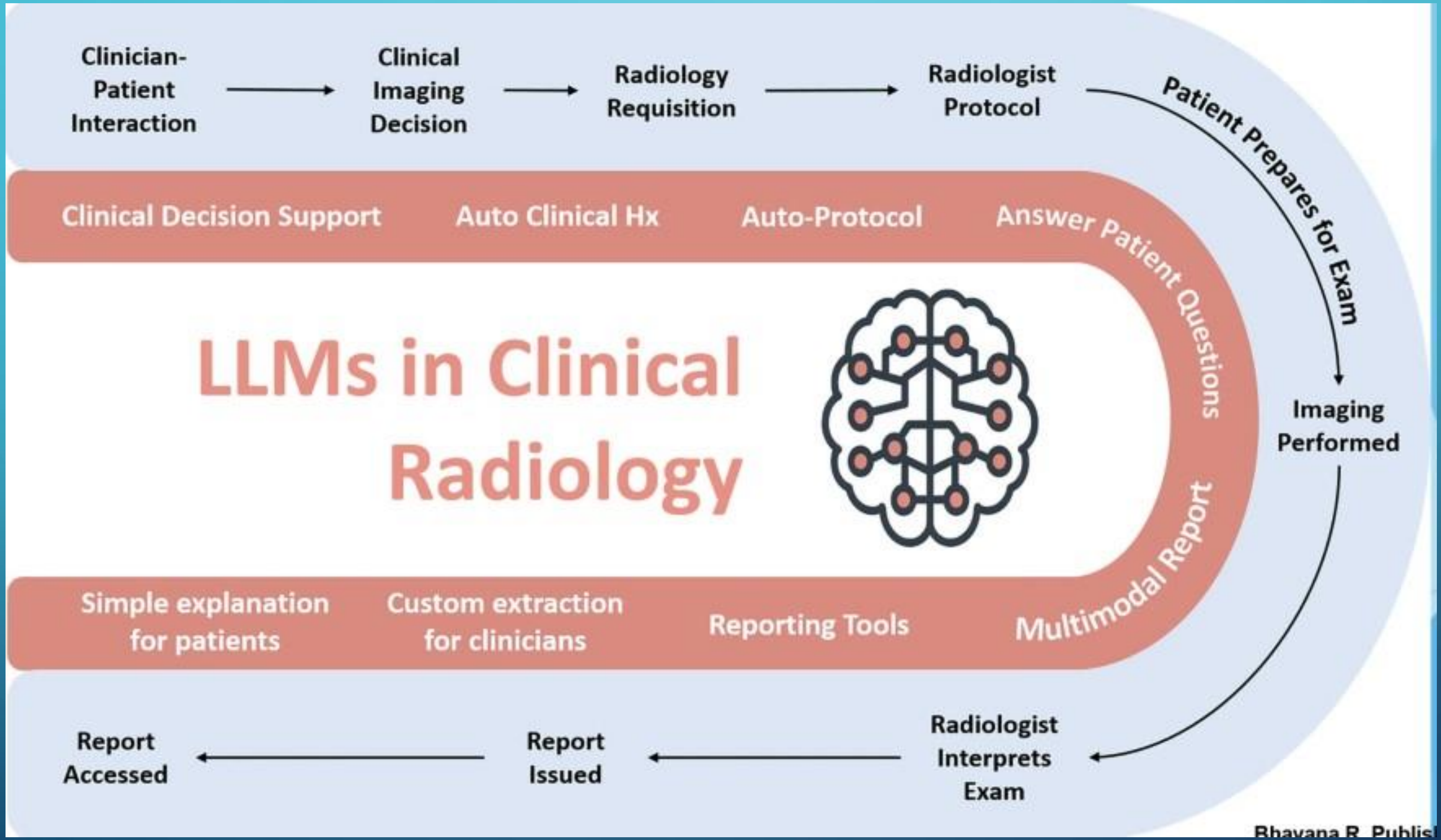
- CHAT GPT riformula testi esistenti … non capisce!
- Per riconoscere un gatto un bambino basta che ne veda, accarezzi, osservi 10 gatti e dopo capisce subito che è un gatto.


- I sistemi di intelligenza artificiali hanno bisogno di migliaia di immagini di gatto per capire che è un gatto e sbagliano se li viene mostrato uno stregatto!


@teenybiscuit

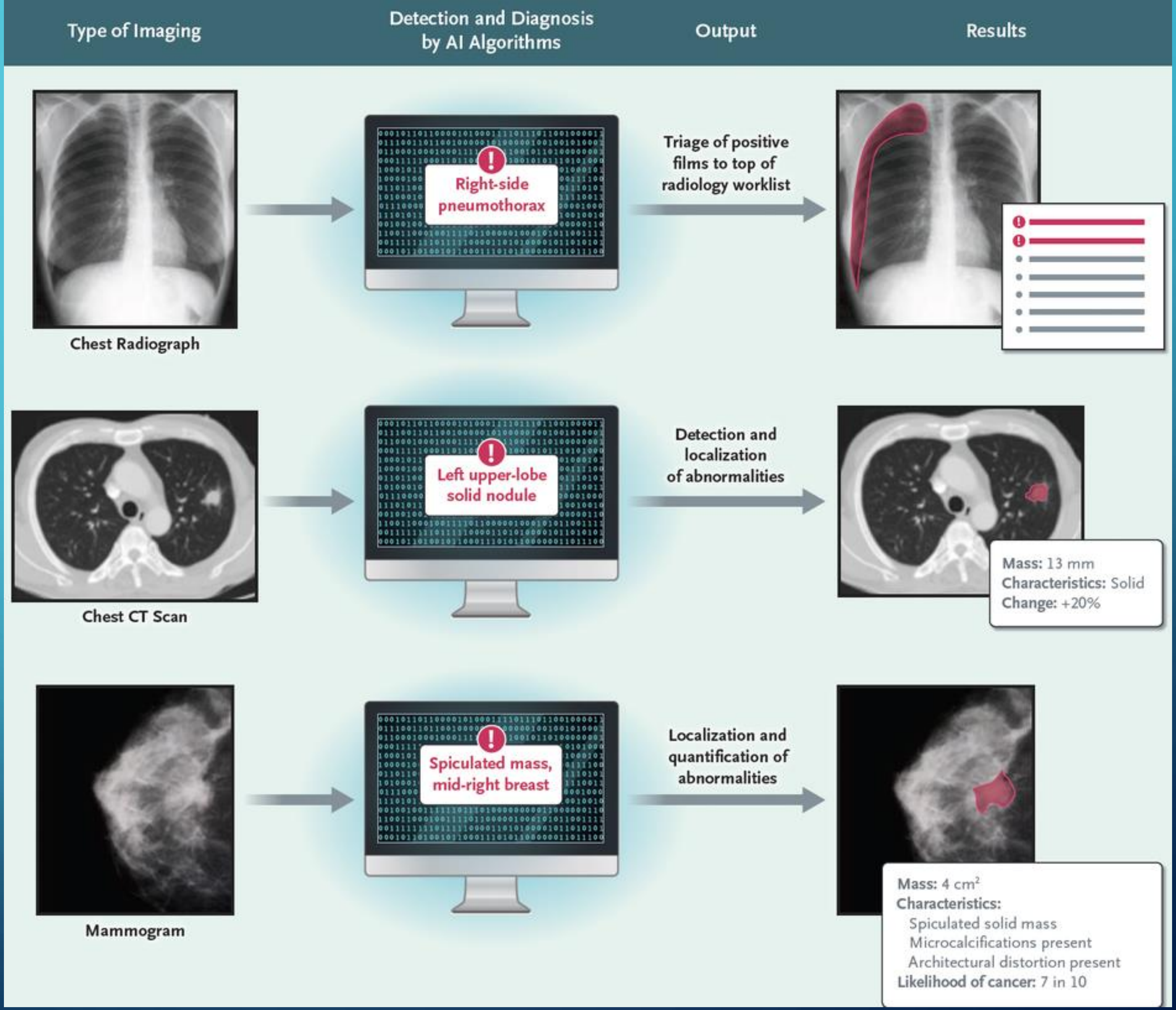
AI IN RADIOLOGIA

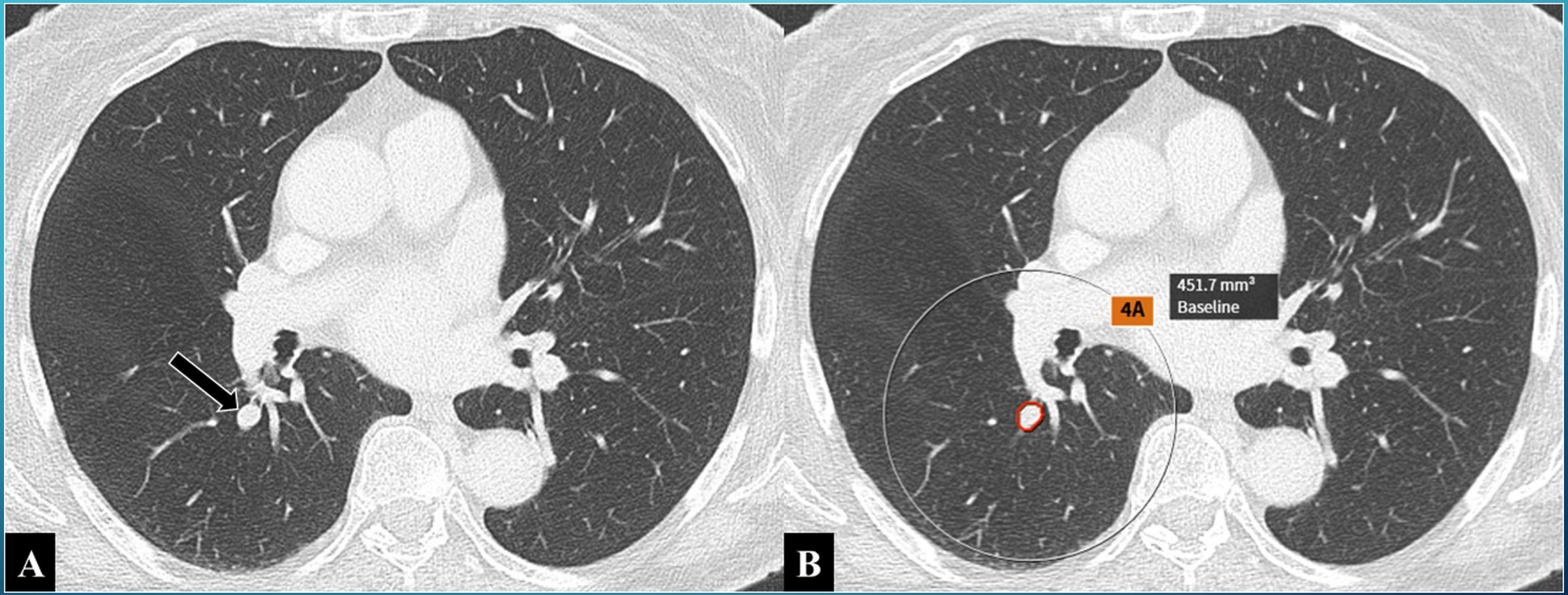
- Interpretativa
- Non interpretativa



Bhayana et al .

Interpretativa

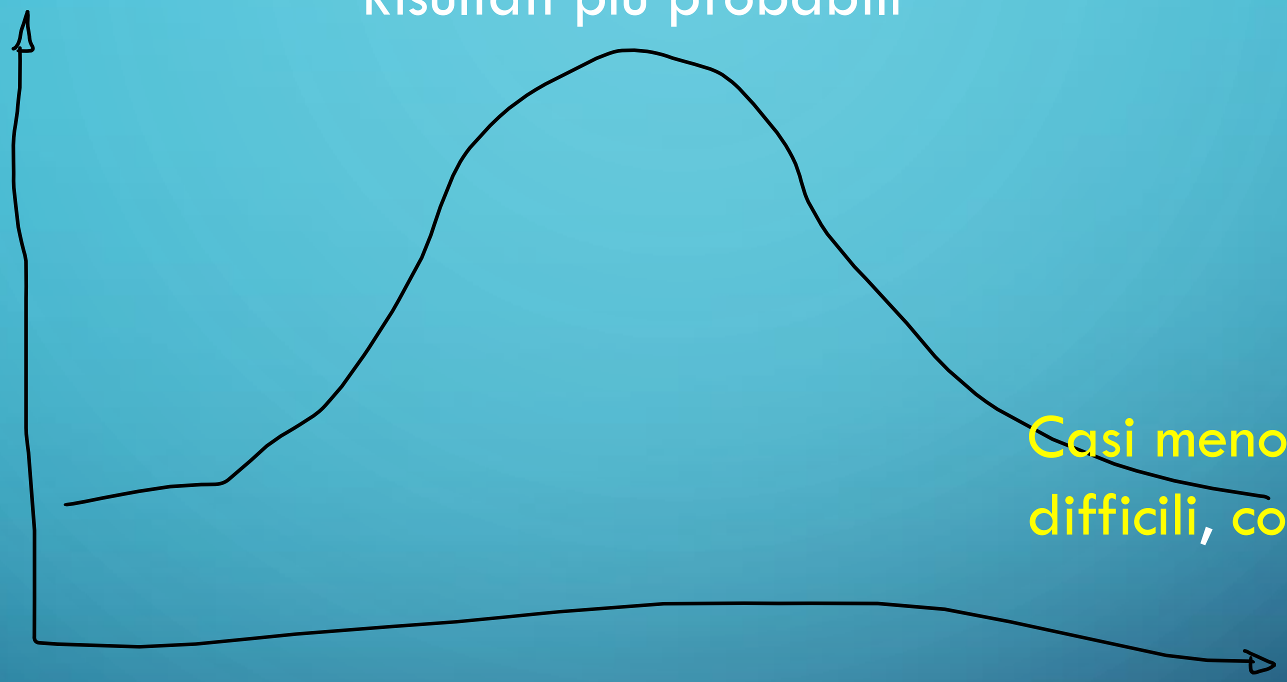



A
B
4A
451.7 mm³
Baseline

DIAGNOSI IN RADIOLOGIA

Risultati più probabili

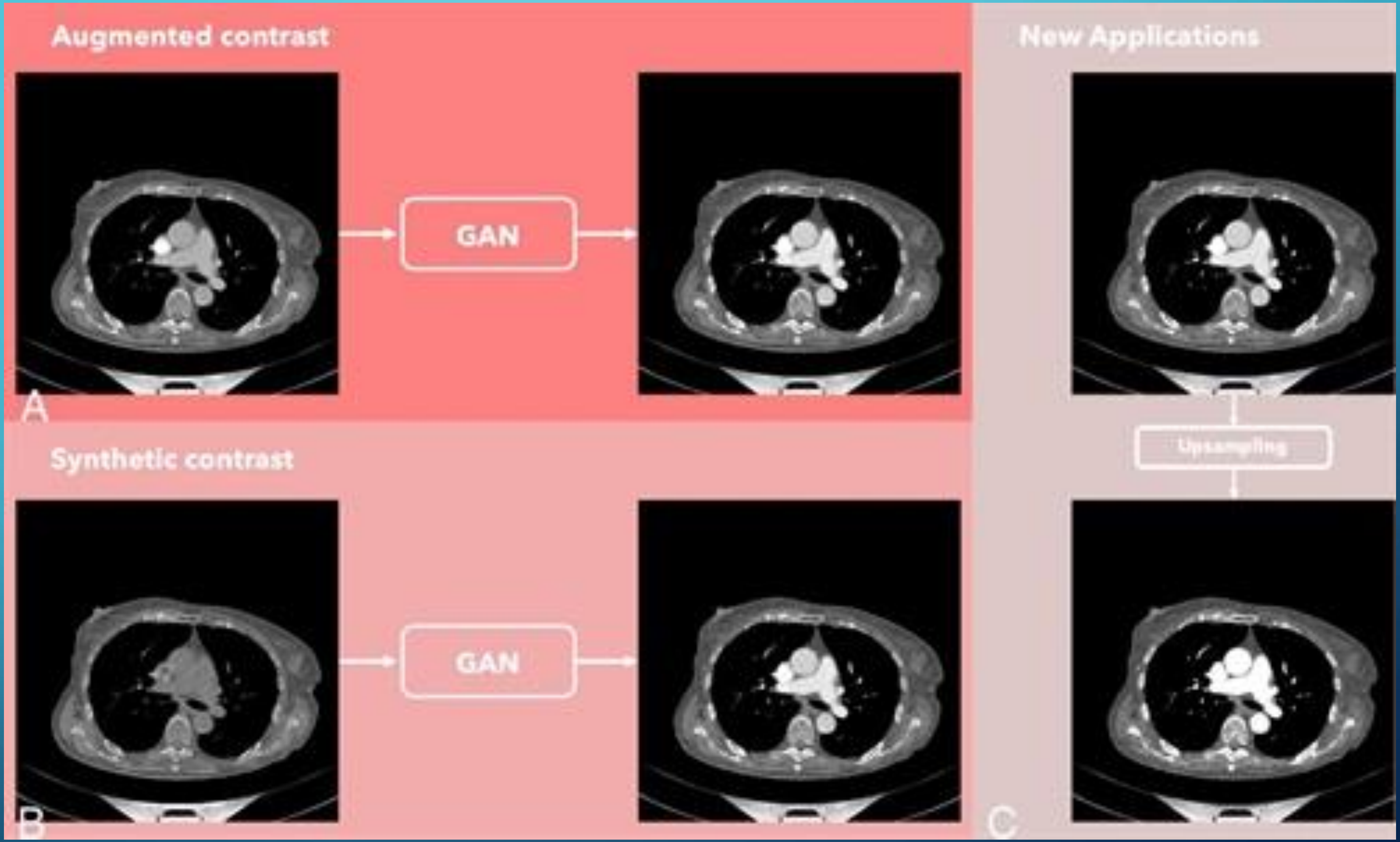
Probabilità



Casi meno probabili, difficili, confounders

Possibili risultati

Non intepretativa



NON È TUTTO ORO QUEL CHE LUCCICA

GPT LLM Performance on RSNA 2023 Case of the Day Questions

Sunday Case of the Day

Genitourinary

History: 25-year old male presenting with …

Question: What is the diagnosis?

A. …
B. …
C. …
D. …

Fig 1. Axial CT scan showing…

CT image is reprinted from Mukherjee et al. Appl Med Artif Intell 2022.

- Retrospective study to evaluate GPT-4V performance compared with that of five radiologists and three junior residents.
- For 72 RSNA 2023 Case of the Day questions, median accuracy of GPT-4V was 43% (31 of 72), that of radiologists was 62% (45 of 72), and that of residents was 61% (44 of 72).
- With the GPT-4V assistance, the median accuracy of radiologists and residents was 54% (39 of 72) for both.

Mukherjee P et al. Published: October 1, 2024
https://doi.org/10.1148/radiol.240609
Radiology

- Usare solo sistemi approvati FDA o EU

- No Dr Goggle o Professor GPT!

AI IN SENOLOGIA

Soprattutto uso interpretativo

Fornisce una valutazione quantitativa della probabilità di malignità sulle microcalcificazioni e noduli / distorsioni

Scala 1-10 o 0-100 o altre rappresentazioni del grado di sospetto.

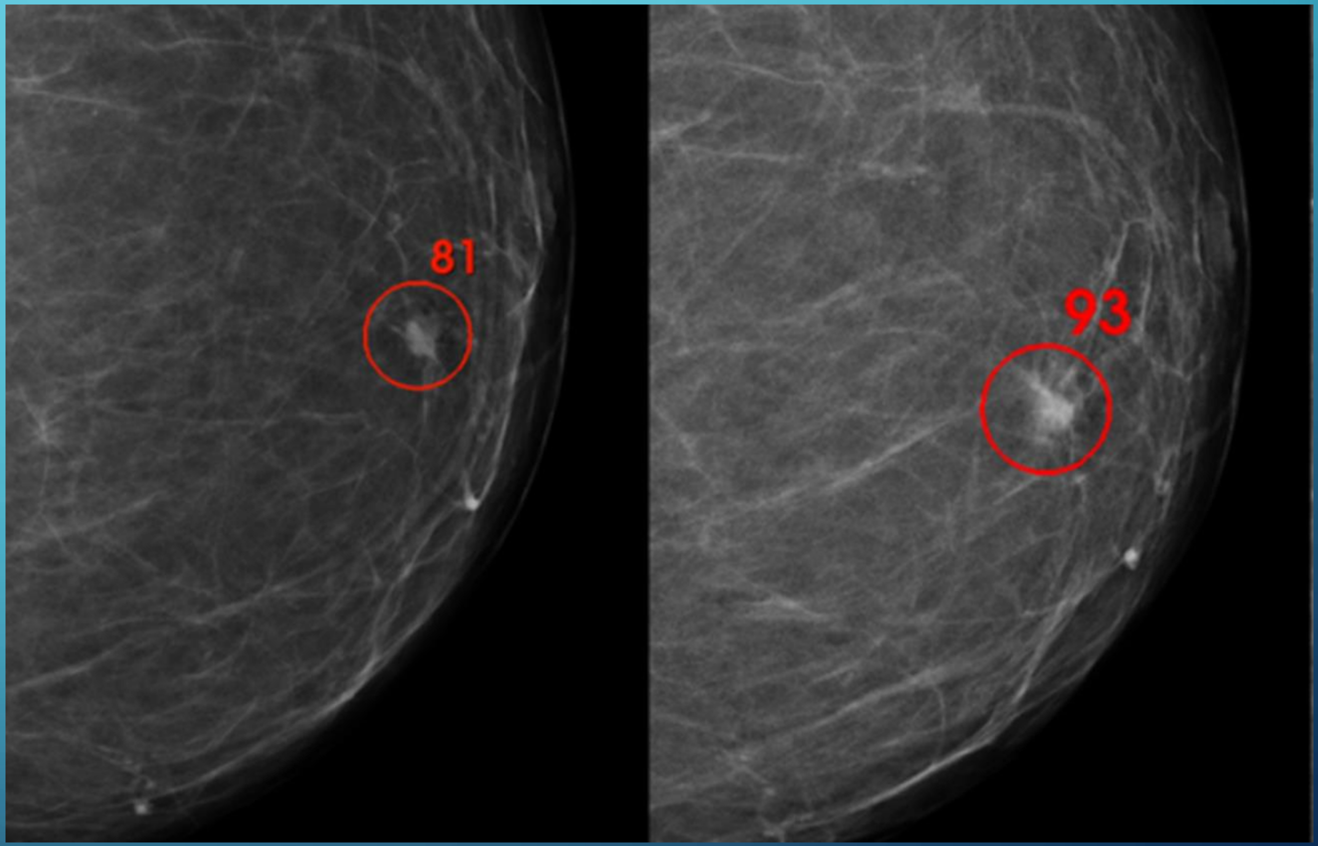


Figure 3. Leading Sites of New Cancer Cases and Deaths – 2024 Estimates

Estimated New Cases

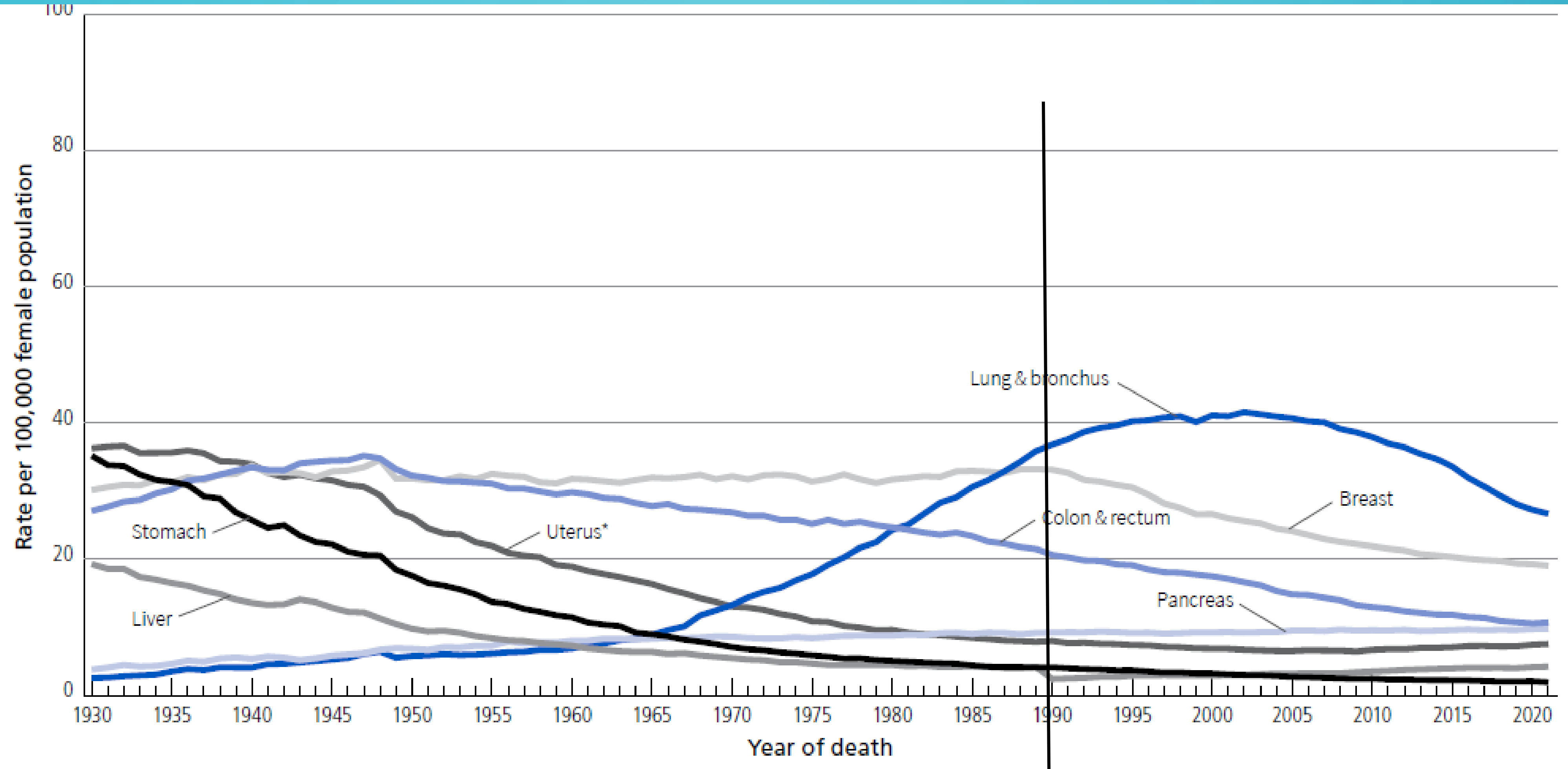
Male			Female		
Prostate	299,010	29%	Breast	310,720	32%
Lung & bronchus	116,310	11%	Lung & bronchus	118,270	12%
Colon & rectum	81,540	8%	Colon & rectum	71,270	7%
Urinary bladder	63,070	6%	Uterine corpus	67,880	7%
Melanoma of the skin	59,170	6%	Melanoma of the skin	41,470	4%
Kidney & renal pelvis	52,380	5%	Non-Hodgkin lymphoma	36,030	4%
Non-Hodgkin lymphoma	44,590	4%	Pancreas	31,910	3%
Oral cavity & pharynx	41,510	4%	Thyroid	31,520	3%
Leukemia	36,450	4%	Kidney & renal pelvis	29,230	3%
Pancreas	34,530	3%	Leukemia	26,320	3%
All sites	1,029,080		All sites	972,060	

Estimated Deaths

Male			Female		
Lung & bronchus	65,790	20%	Lung & bronchus	59,280	21%
Prostate	35,250	11%	Breast	42,250	15%
Colon & rectum	28,700	9%	Pancreas	24,480	8%
Pancreas	27,270	8%	Colon & rectum	24,310	8%
Liver & intrahepatic bile duct	19,120	6%	Uterine corpus	13,250	5%
Leukemia	13,640	4%	Ovary	12,740	4%
Esophagus	12,880	4%	Liver & intrahepatic bile duct	10,720	4%
Urinary bladder	12,290	4%	Leukemia	10,030	3%
Non-Hodgkin lymphoma	11,780	4%	Non-Hodgkin lymphoma	8,360	3%
Brain & other nervous system	10,690	3%	Brain & other nervous system	8,070	3%
All sites	322,800		All sites	288,920	

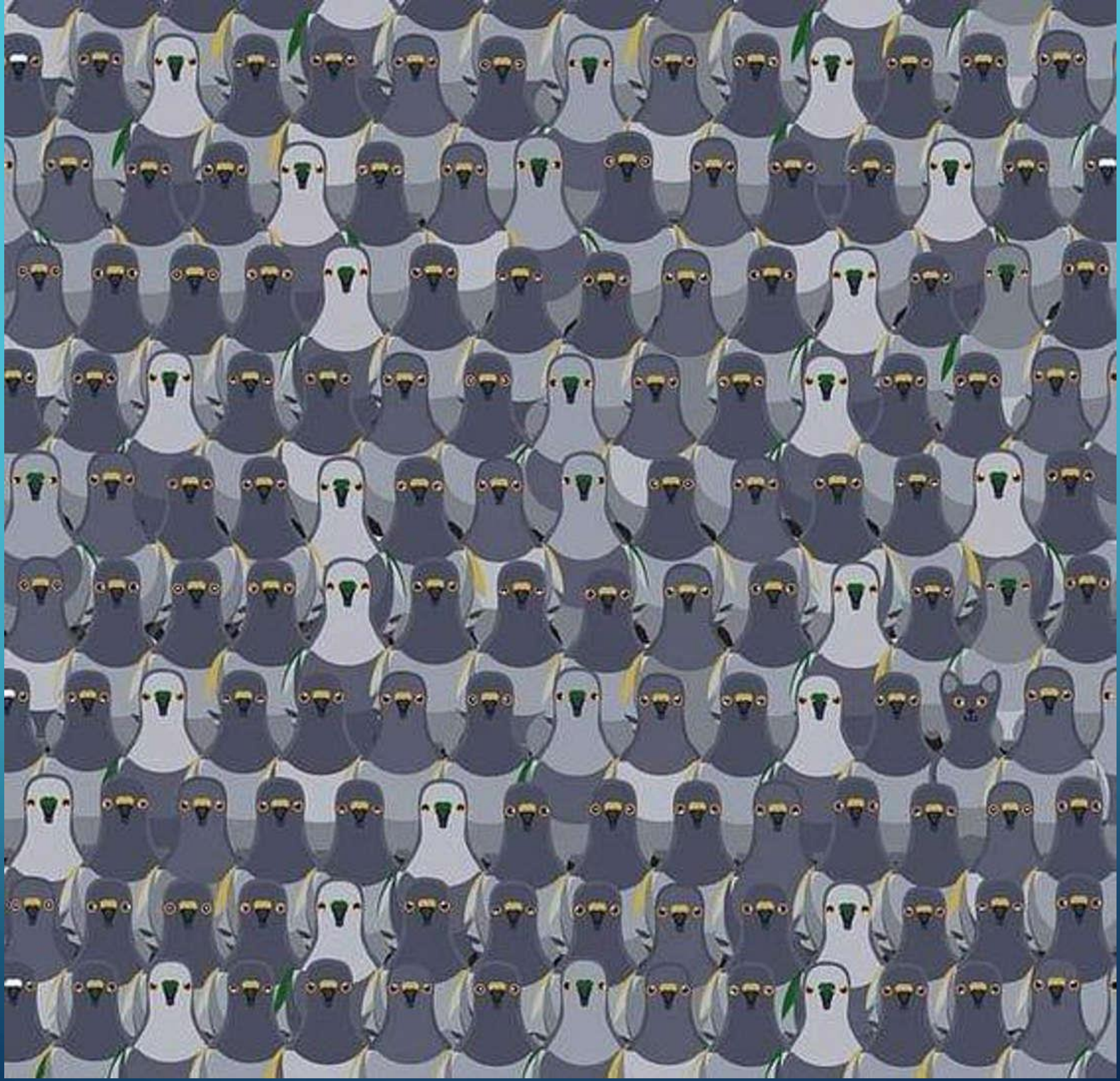
Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder. Estimates do not include Puerto Rico or other US territories. Ranking is based on modeled projections and may differ from the most recent observed data.

- Ancora piu’ difficile quando parliamo di screening

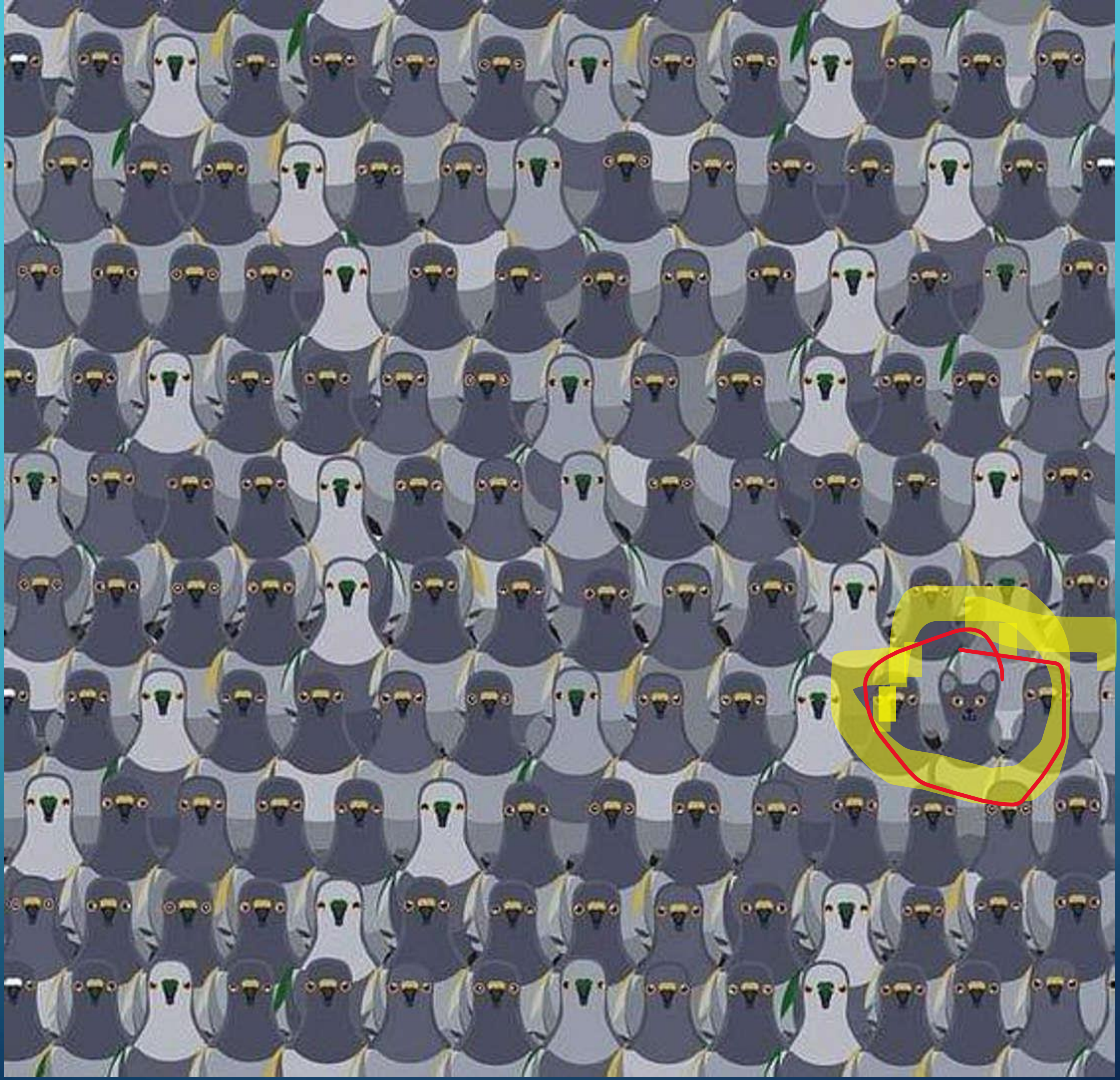


Rates are age adjusted to the 2000 US standard population and exclude deaths in Puerto Rico and other US territories. *Uterus refers to uterine cervix and uterine corpus combined. Note: Due to changes in ICD coding, numerator information differs from contemporary data for cancers of the liver, lung and bronchus, colon and rectum, and uterus.

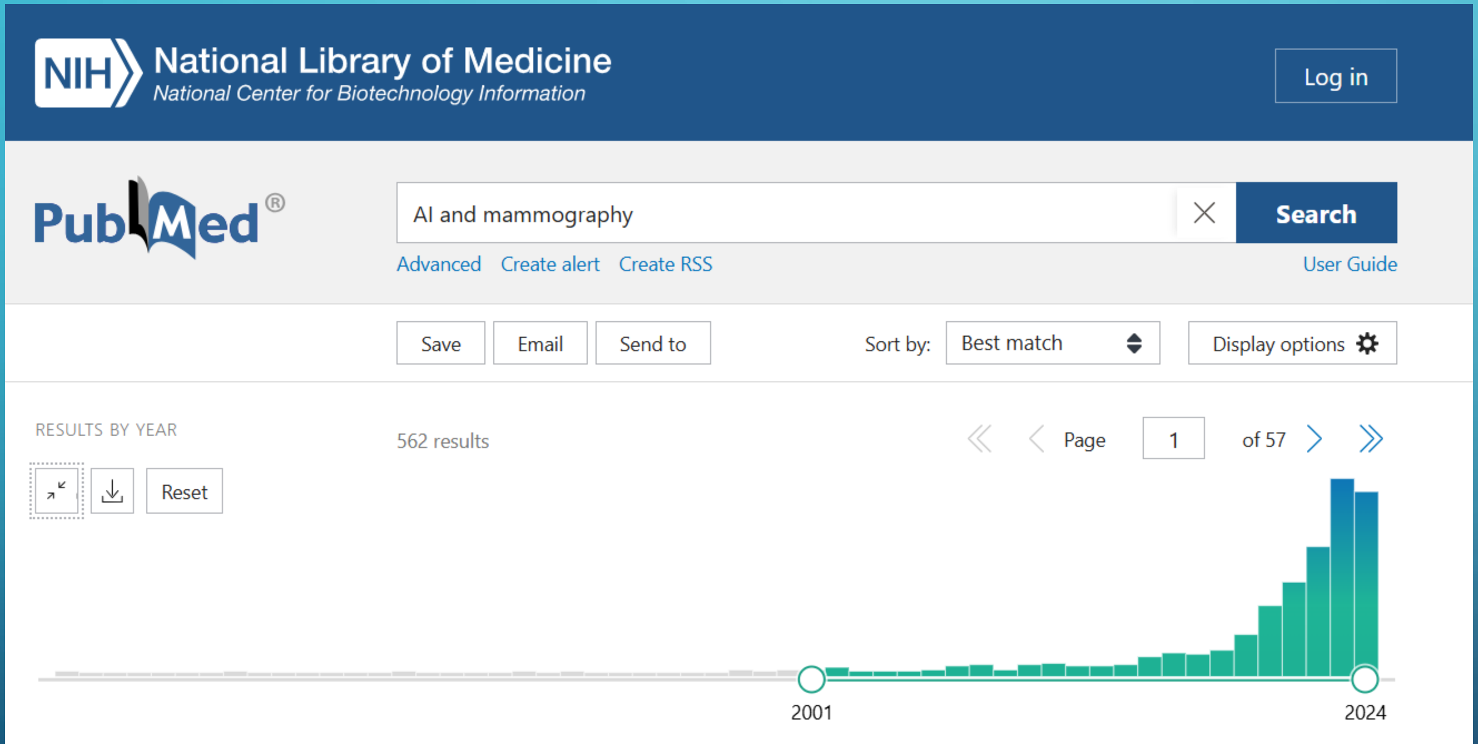
Source: US Mortality Volumes 1930 to 1959, US Mortality Data 1960 to 2020, National Center for Health Statistics, Centers for Disease Control and Prevention.



Dov'è il gatto?



DATI IN LETTERATURA AI IN SENOLOGIA



148 articoli 2023

138 articoli 1.9.2024

- Cosa dice la letteratura?

DATI IN LETTERATURA AI IN SENOLOGIA

Artificial intelligence-supported screen reading versus standard double reading in the Mammography Screening with Artificial Intelligence trial (MASAI): a clinical safety analysis of a randomised, controlled, non-inferiority, single-blinded, screening accuracy study

Kristina Lång, Viktoria Josefsson, Anna-Maria Larsson, Stefan Larsson, Charlotte Högberg, Hanna Sartor, Solveig Hofvind, Ingvar Andersson, Aldana Rosso

Lang et al; Lancet Oncol.2023

MASAI STUDY

- 80000 pazienti di screening in Svezia
- AI-supported mammography screening resulted in a similar cancer detection rate compared with standard double reading, with a substantially lower screen-reading workload, indicating that the use of AI in mammography screening is safe.

Lang et al; Lancet Oncol.2023

Radiology

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Evidence-based Practice–Centennial Content

Free Access

Standalone AI for Breast Cancer Detection at Screening Digital Mammography and Digital Breast Tomosynthesis: A Systematic Review and Meta-Analysis

Jung Hyun Yoon, Fredrik Strand, Pascal A. T. Baltzer, Emily F. Conant, Fiona J. Gilbert, Constance D. Lehman, Elizabeth A. Morris, Lisa A. Mullen, Robert M. Nishikawa, Nisha Sharma, Ilse Vejborg, Linda Moy*, Ritse M. Mann*

* L.M. and R.M.M. are co-senior authors.

Author Affiliations

Standalone AI for screening digital mammography performed **as well as or better** than radiologists. Compared with digital mammography,

Radiology

ORIGINAL RESEARCH • BREAST IMAGING

Early Indicators of the Impact of Using AI in Mammography Screening for Breast Cancer

Andreas D. Lauritzen, PhD • Martin Lillholm, PhD • Elsebeth Lynge, PhD • Mads Nielsen, PhD • Nico Karssemeijer, PhD • Ilse Vejborg, MD

From the Departments of Computer Science (A.D.L., M.L., M.N.) and Public Health (E.L.), University of Copenhagen, Copenhagen, Denmark; Department of Breast Examinations, Gentofte Hospital, Kildegårdsvej 30A, 2900 Hellerup, Denmark (A.D.L., I.V.); Department of Radiology and Nuclear Medicine, Radboud University Medical Center, Nijmegen, the Netherlands (N.K.); and ScreenPoint Medical, Nijmegen, the Netherlands (N.K.). Received September 19, 2023; revision requested November 7; final revision received March 17, 2024; accepted March 27. **Address correspondence to** A.D.L. (email: *al@di.ku.dk*).

Supported in part by Eurostars (grant E9714 IBSCREEN). Supported in part by the Pioneer Centre for Artificial Intelligence (Danmarks Grundforskningsfond, grant P1).

Conflicts of interest are listed at the end of this article.

See also the editorial by Lee and Friedewald in this issue.

Radiology 2024; 311(3):e232479 • https://doi.org/10.1148/radiol.232479 • Content codes: BR AI

Lauritzen AD et al JUNE2024

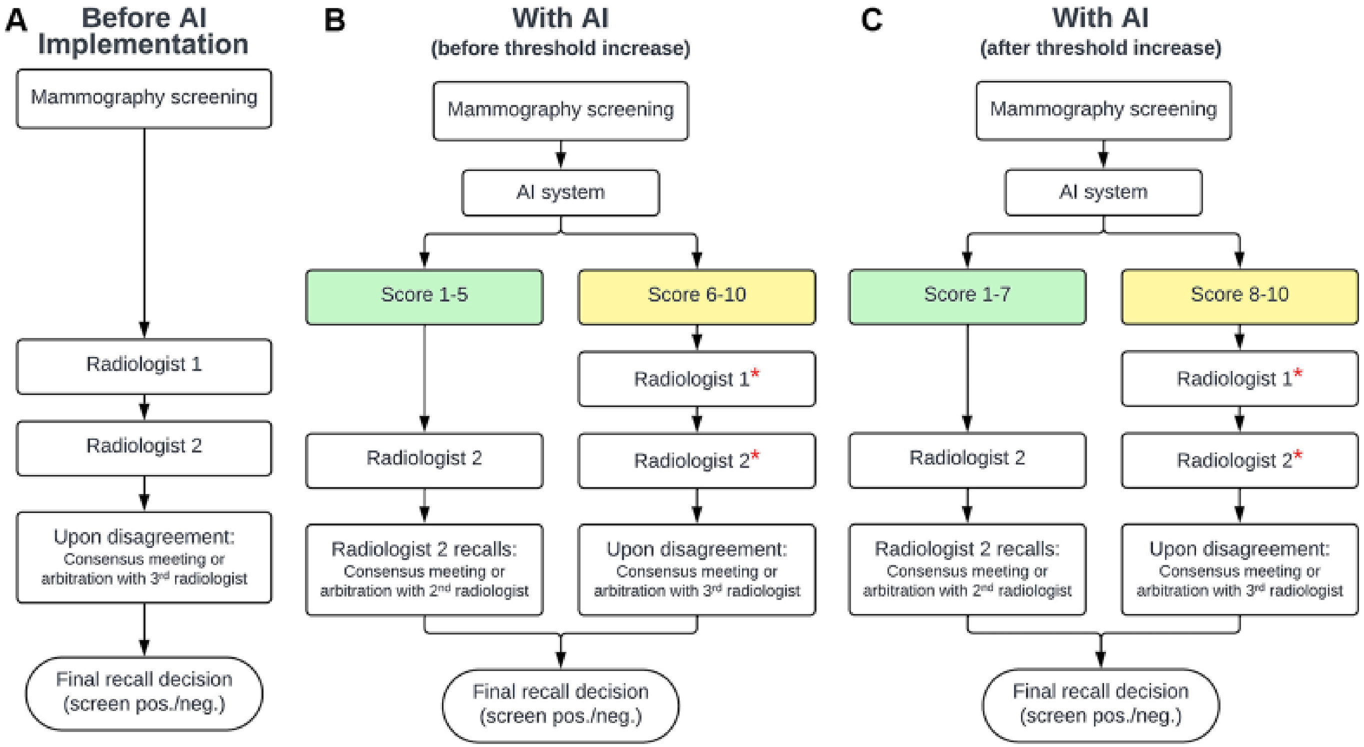


Figure 2: Flow diagram depicts mammography reading protocols **(A)** before an artificial intelligence (AI) system was implemented in screening and **(B, C)** after the AI system was implemented with **(B)** the original (before May 3, 2022) or **(C)** a higher (on or after May 3, 2022) AI examination score threshold for selecting screenings for single reading. Green boxes indicate likely normal screenings selected for single reading; yellow boxes indicate screenings selected for AI-assisted double reading, in which case radiologists (*) had access to decision support in the form of highlighted lesions provided by the AI system. neg. = negative, pos. = positive.

Results

…After AI system implementation,

the recall rate decreased by 20.5% (3.09% before AI…vs 2.46% with AI …; $P < .001$),

the cancer detection rate increased (0.70% …vs 0.82% … $P = .01$), the false-positive rate decreased (2.39% …vs 1.63% …$P < .001$),

the positive predictive value increased (22.6% [423 of 1875] vs 33.6% …$P < .001$),

the rate of small cancers (≤1 cm) increased (36.6% …vs 44.9% …

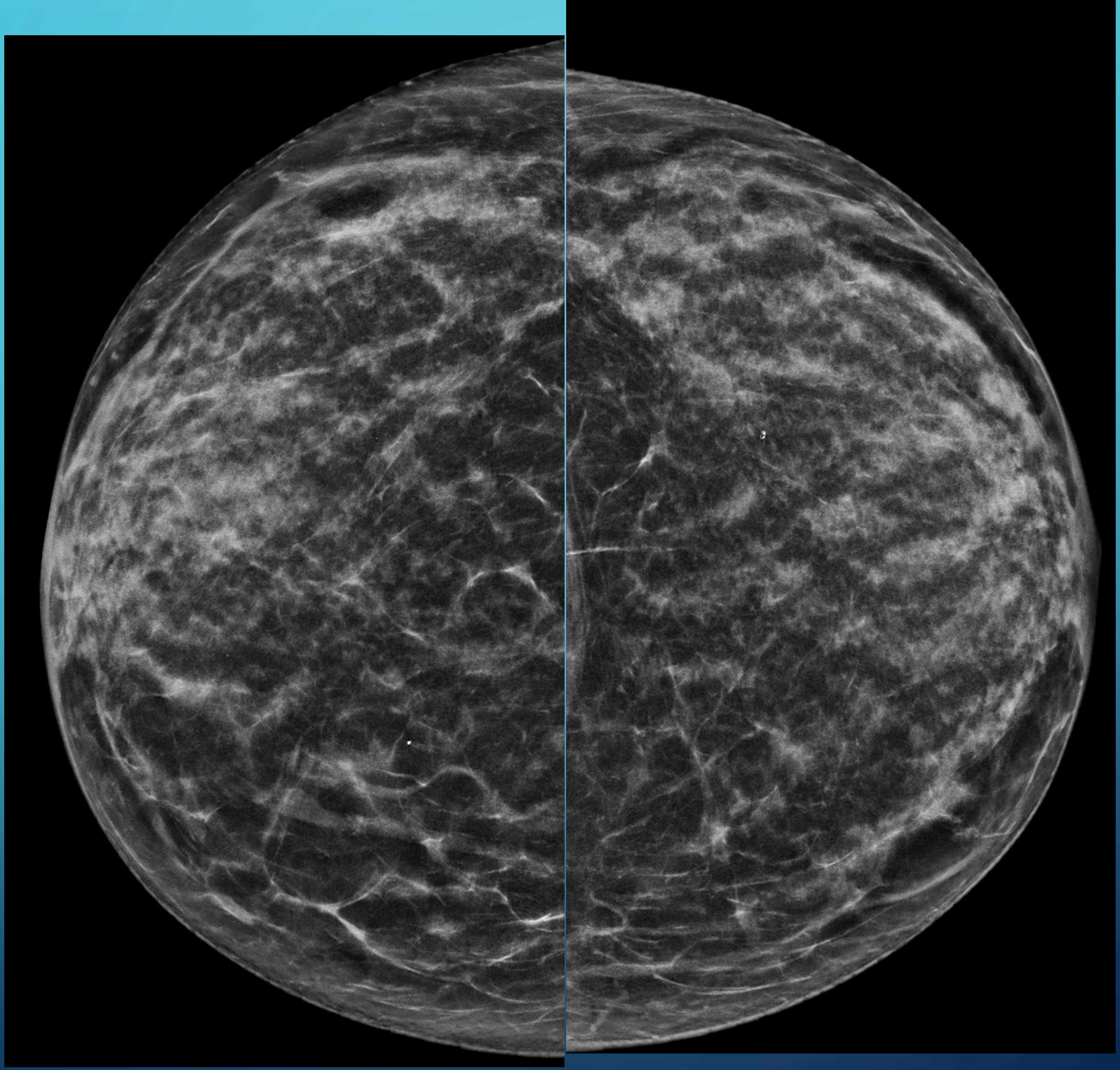
The reading workload was reduced by 33.5% (38 977 of 116 492 reads).

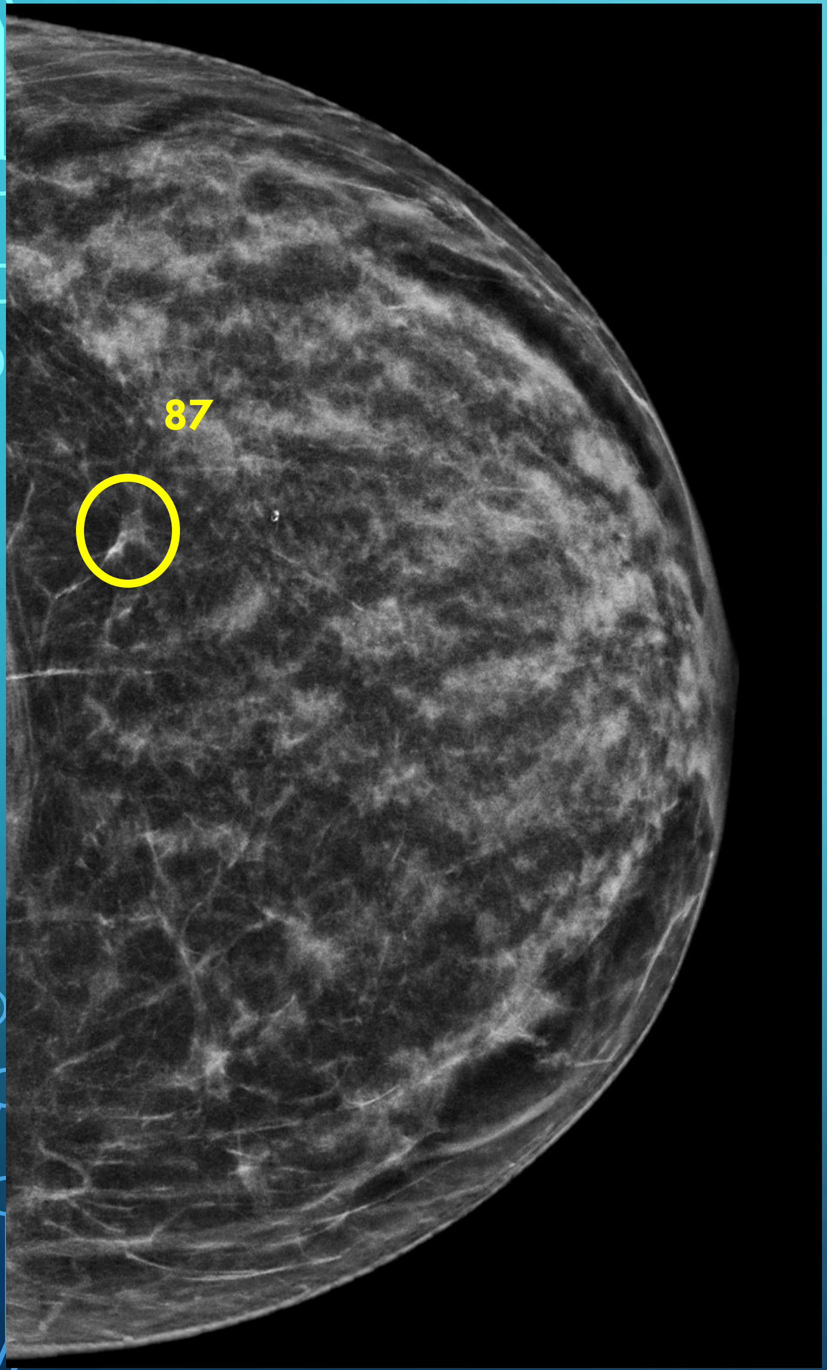
Conclusion

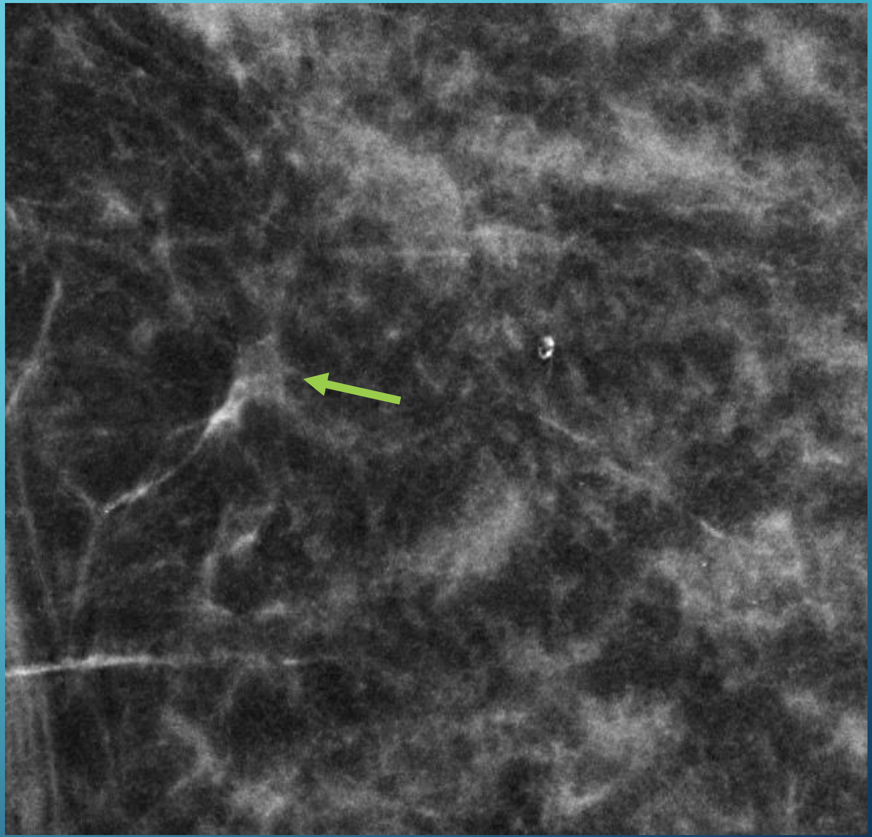
In a population-based mammography screening program, using AI **reduced the overall workload of breast radiologists while improving screening performance.**

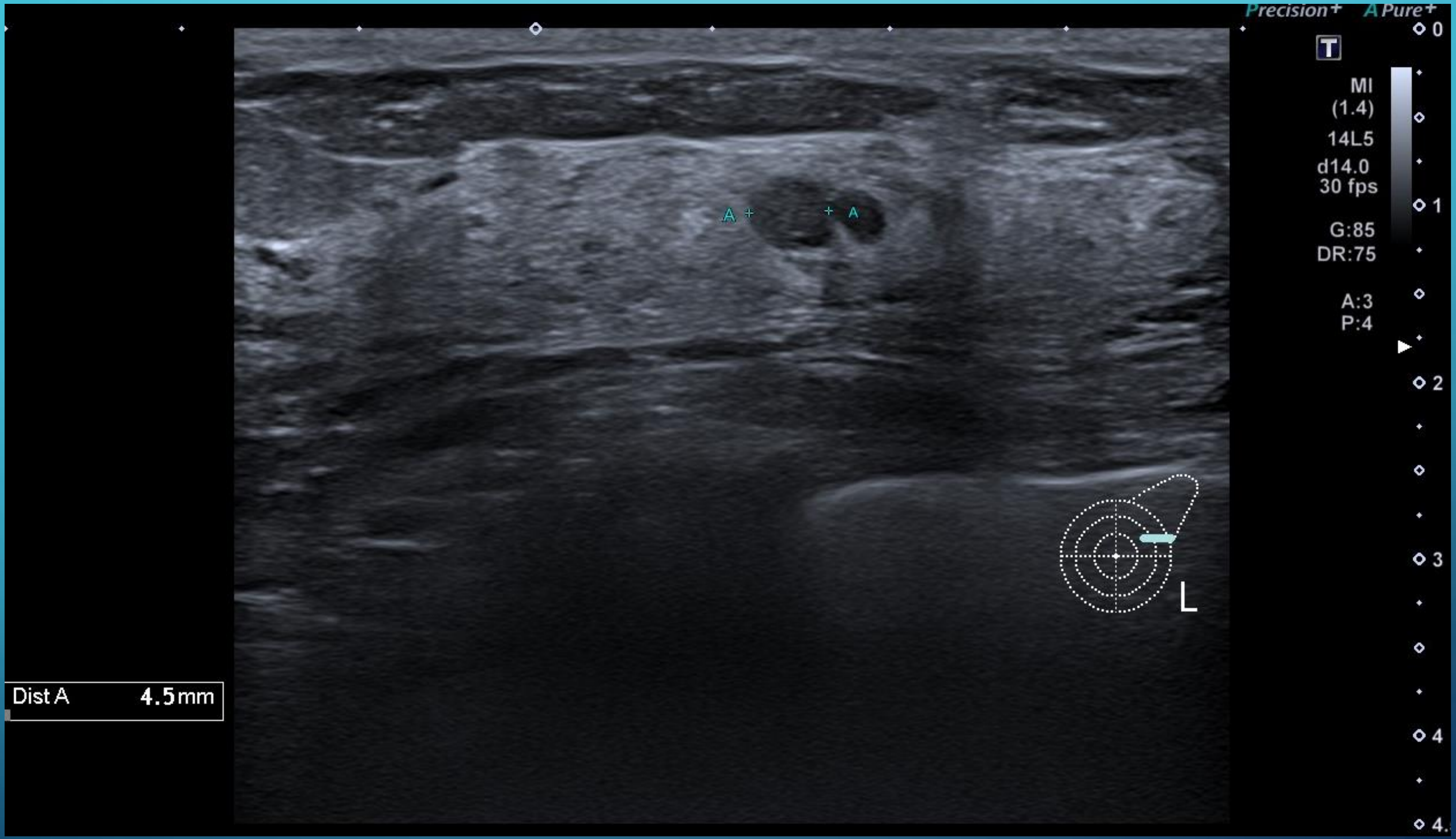
- Ma solo nello screening?

47 aa
asintomatica
Prima
mammografia



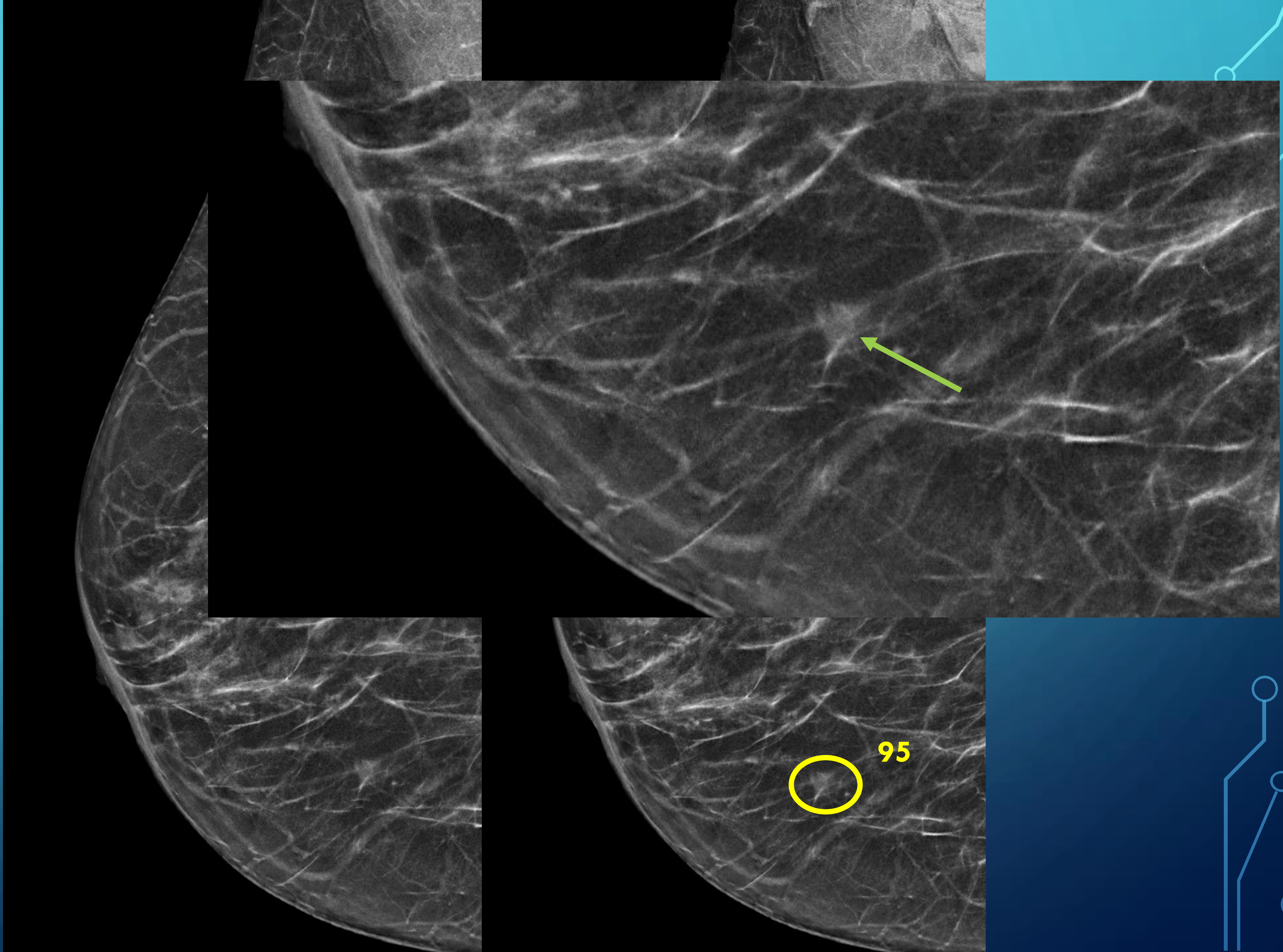

87

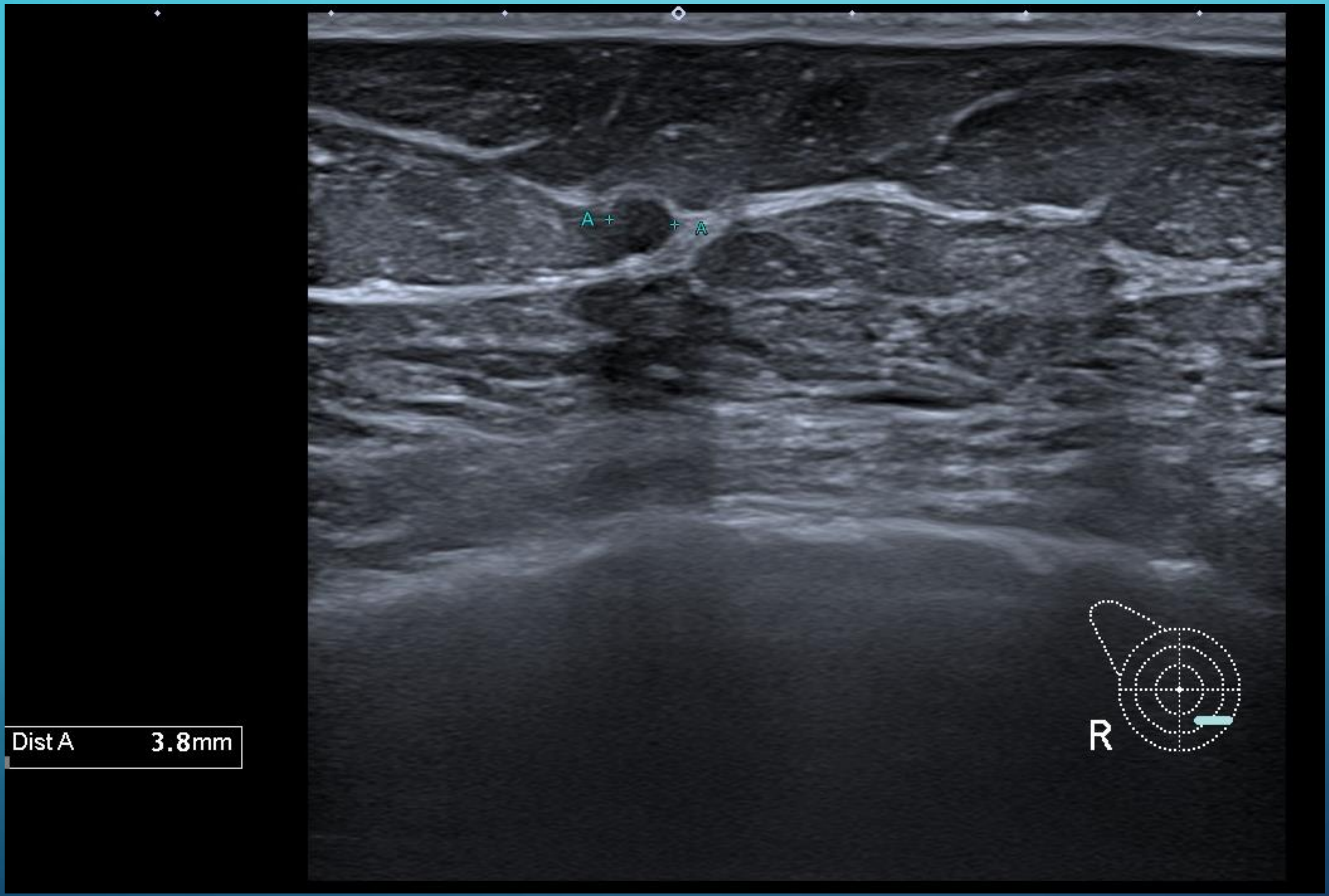




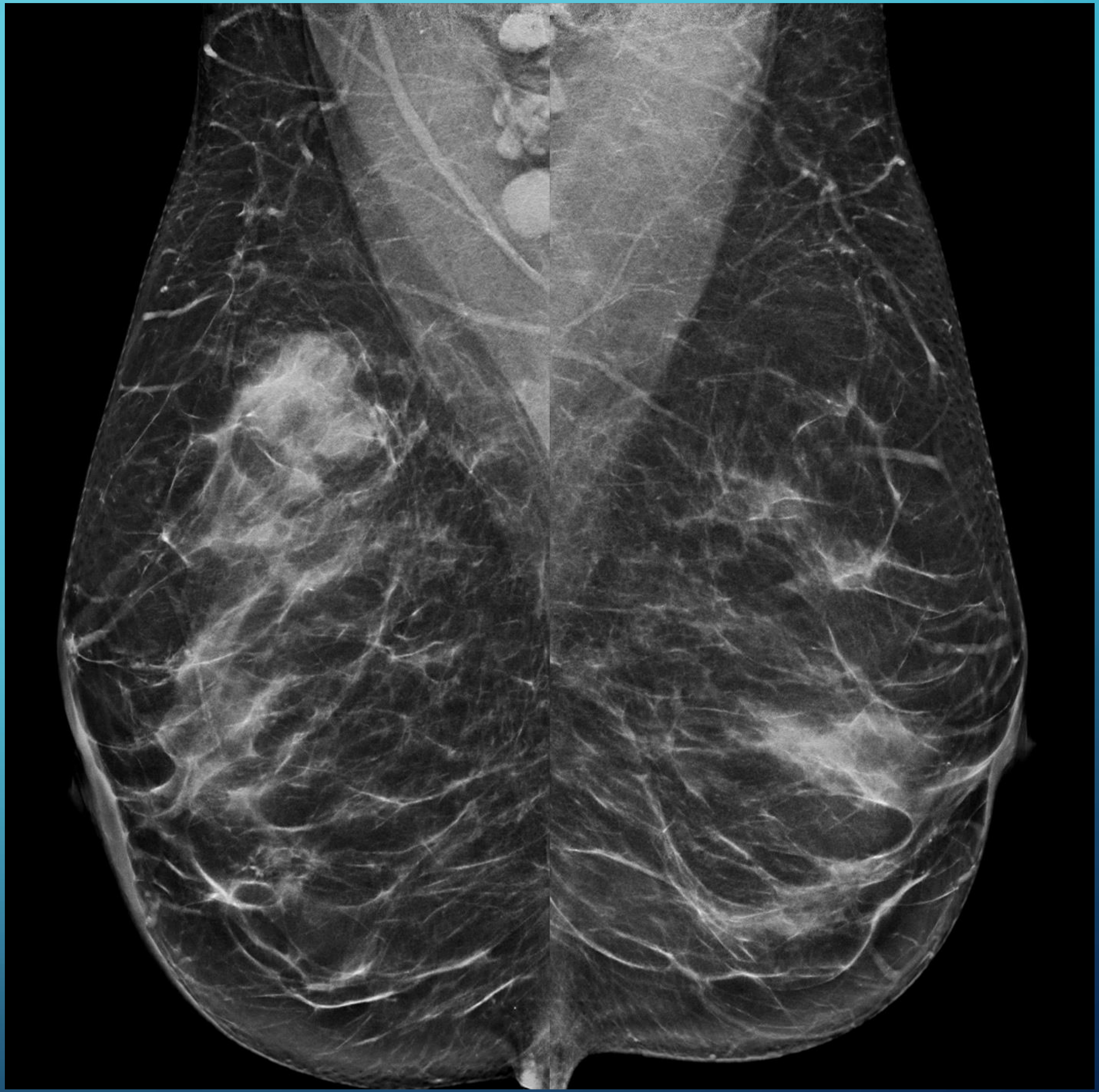
Precision+
Pure+
MI
(1.4)
14L5
d14.0
30 fps
G:85
DR:75
A:3
P:4
0
1
2
3
4
L
Dist A 4.5mm

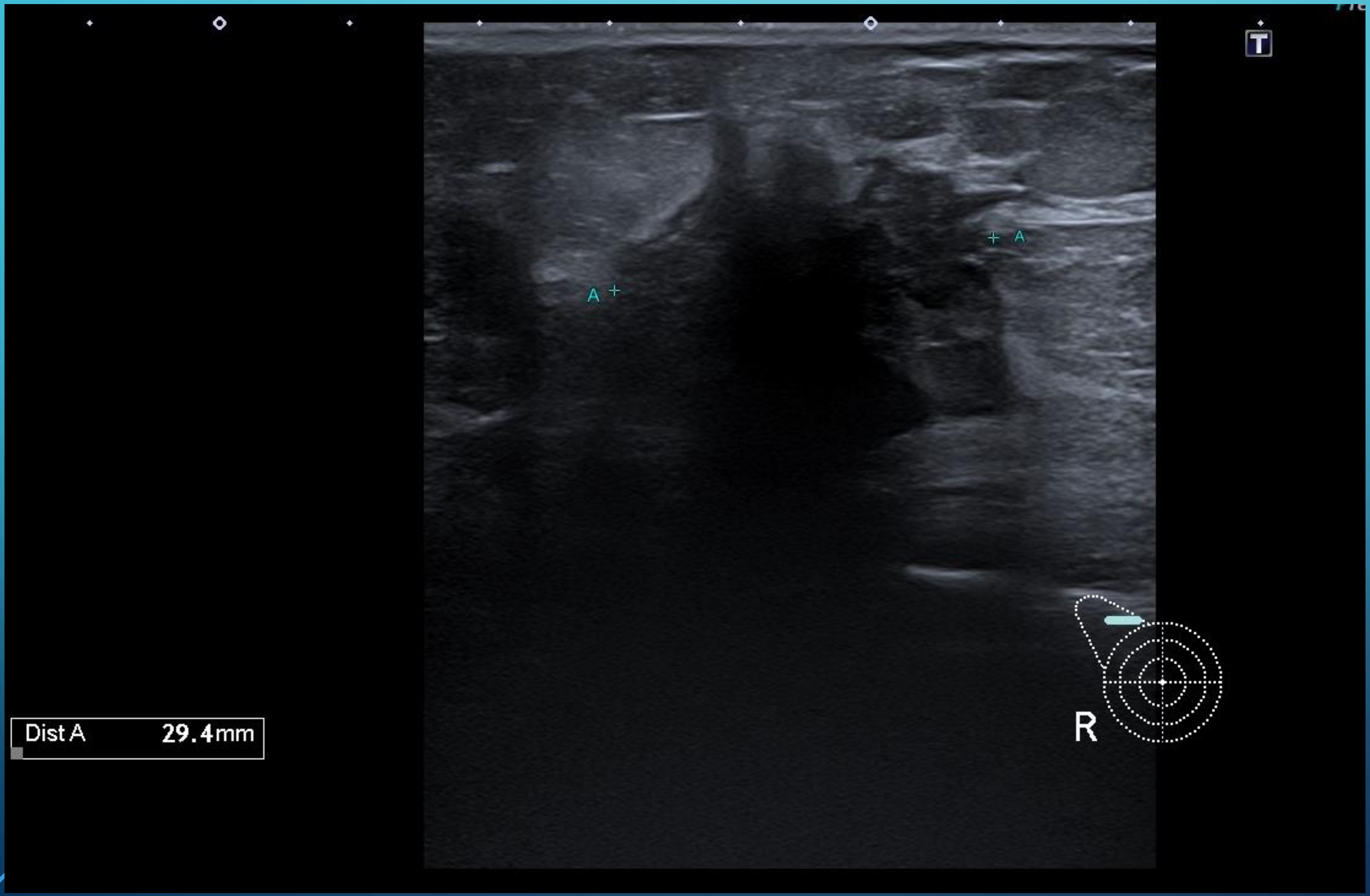
49 aa
asintomatica
Precedente
negativo



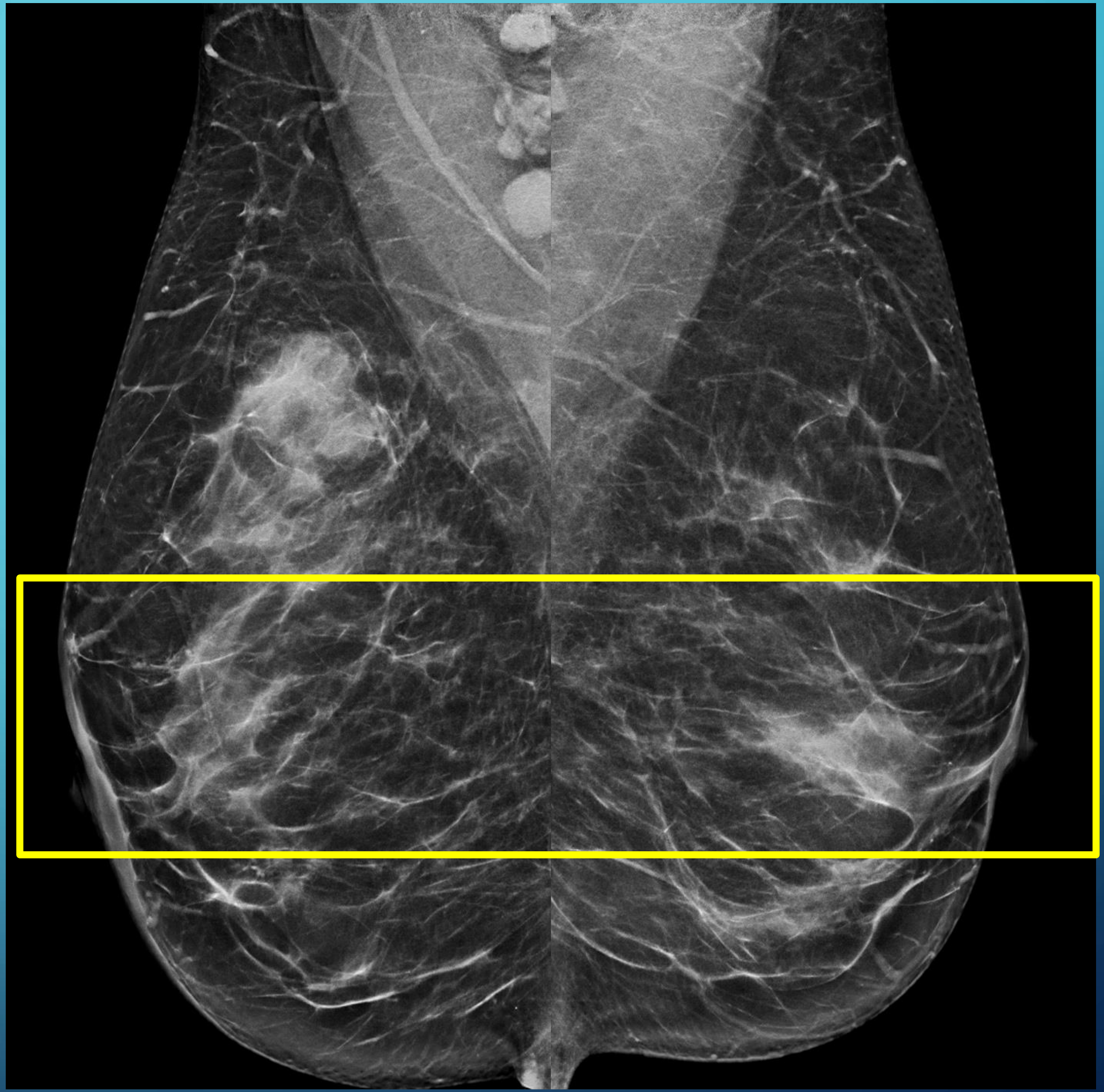

A + + A
Dist A 3.8mm
R

- 46 aa sensazione di nodulo a dx
- Prima mammografia

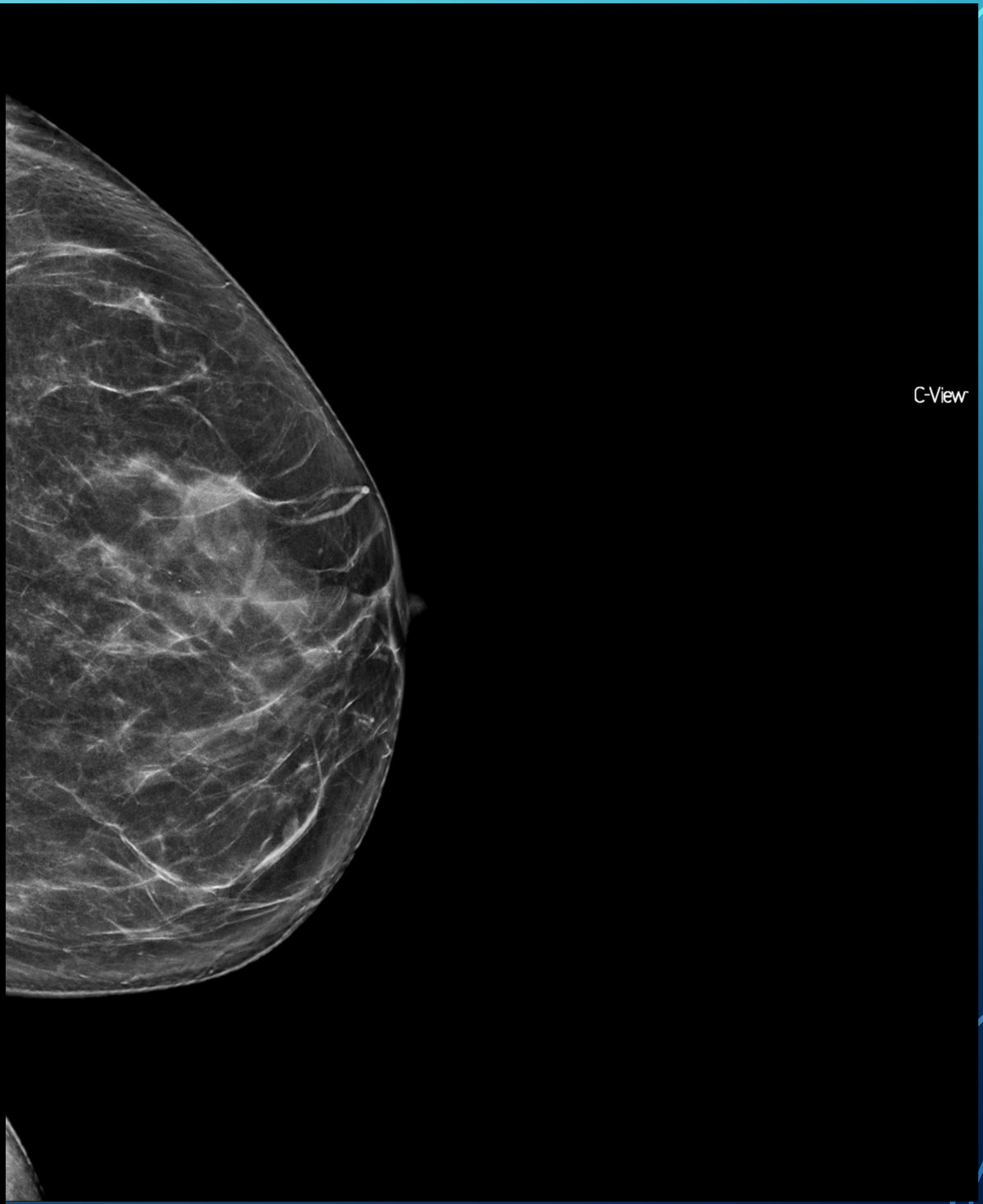


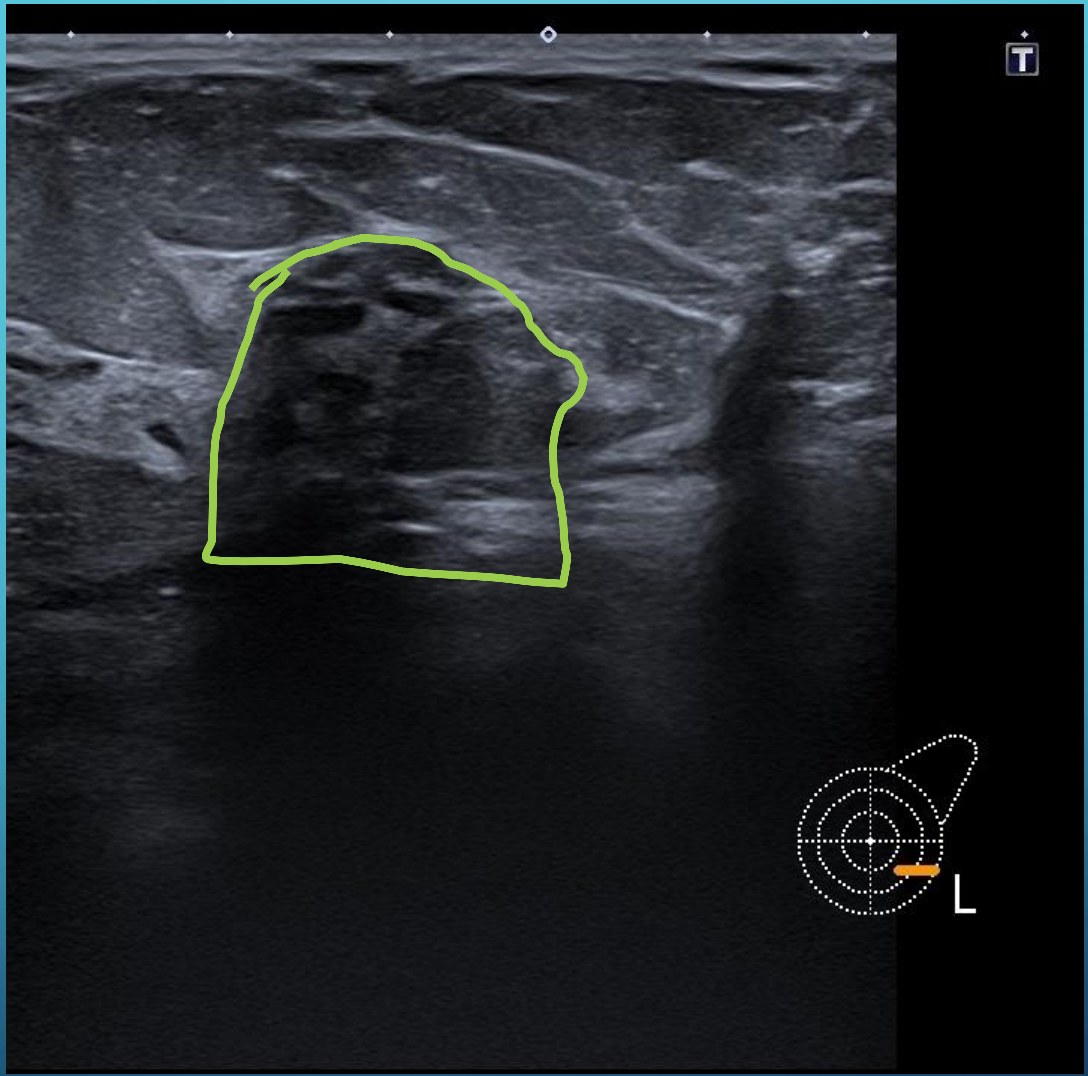


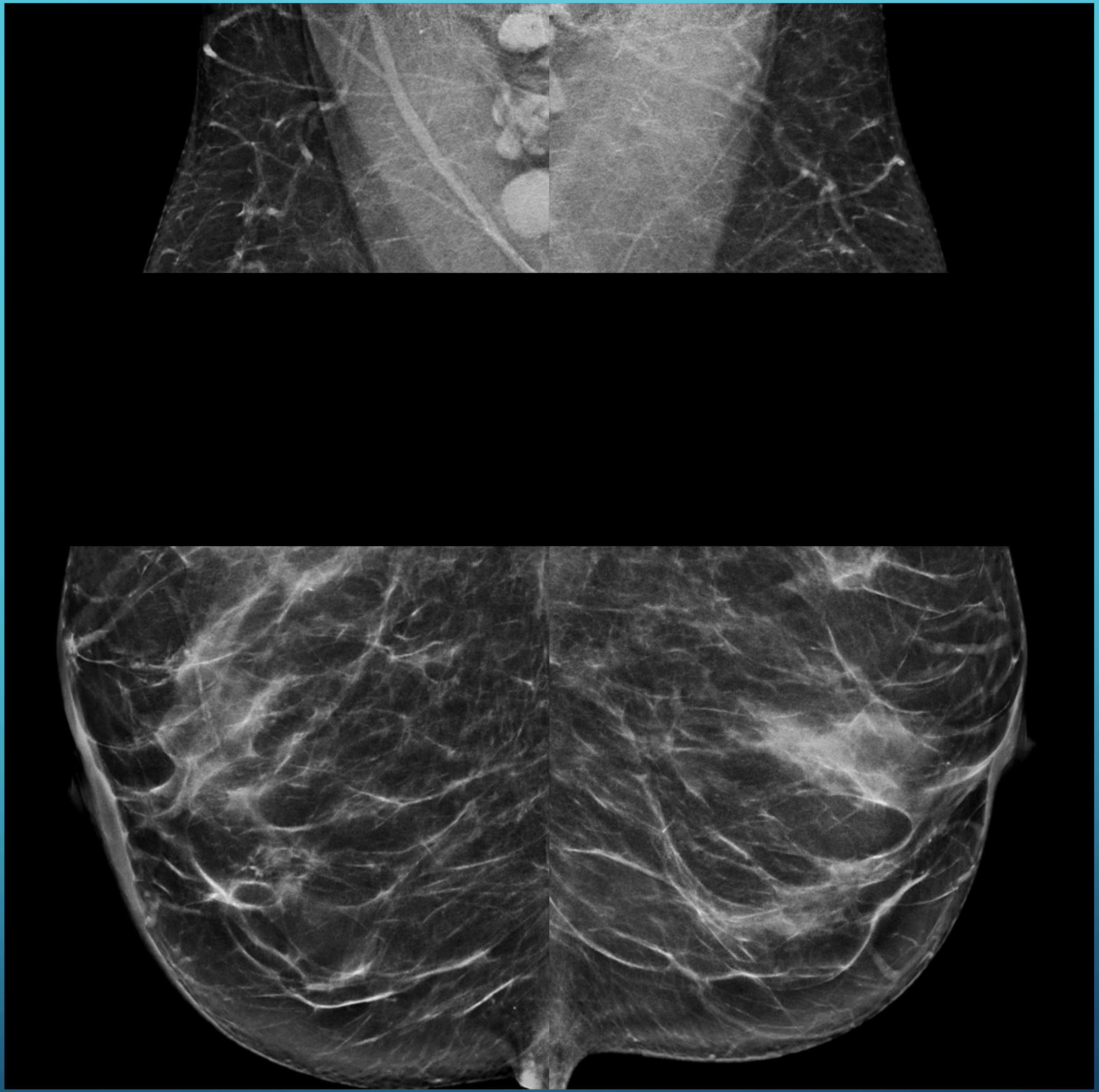
Dist A 29.4mm
R




C-View


C-View


T
L



LIMITI DELL'INTELLIGENZA ARTIFICIALE

- Sistemi alcuni non completi.
- Alcuni falsi positivi banali: se istruiti all'errore possono migliorare e non lo ripetono più !
- Costi(?)
- Protezione dei dati e sicurezza in generale sulla provenienza, costruzione, inattaccabilità del software

CONCLUSIONI

- L'intelligenza artificiale **è già qui**… anche se non è ancora una intelligenza!
- Sta a noi sfruttarla al meglio sempre nel rispetto della sicurezza e della etica
- In senologia aiuta il radiologo se ne conosce bene le potenzialità ed i limiti

IL FUTURO

Si arriverà ad una superintelligenza delle macchine?

In medicina e senolgia quanto cambierà il lavoro?

« Il futuro appartiene a quelli che si preparano per esso oggi»

Malcom X

Grazie per l'attenzione!
paolocab@libero.it