SHARSHERET SUMMIT

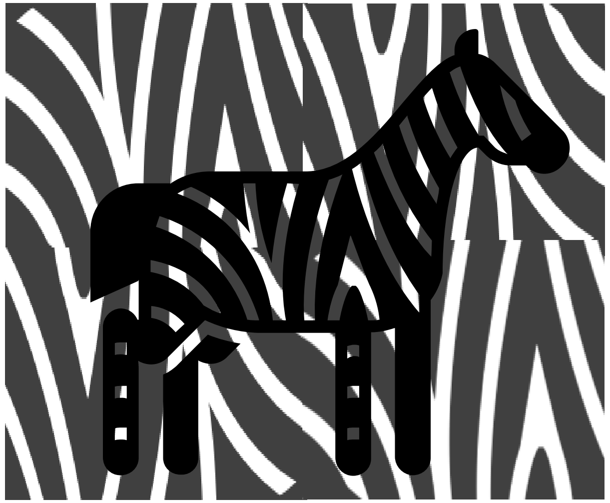
# AI in Breast Cancer Screening

# Learning Objectives

Learn more about how AI is improving cancer screening and diagnosis .

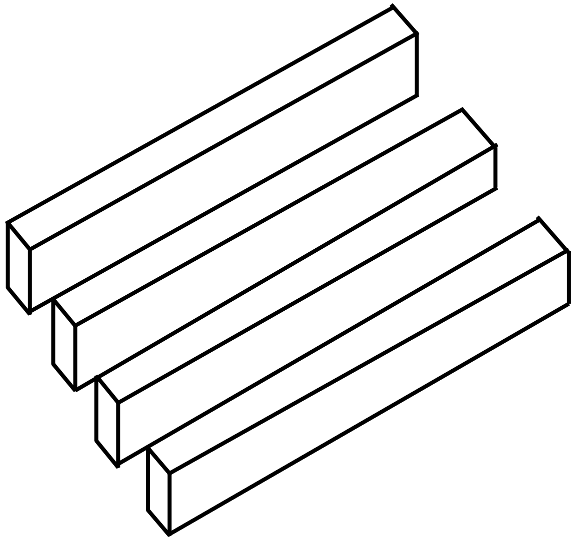
# Introduction to AI

Perception

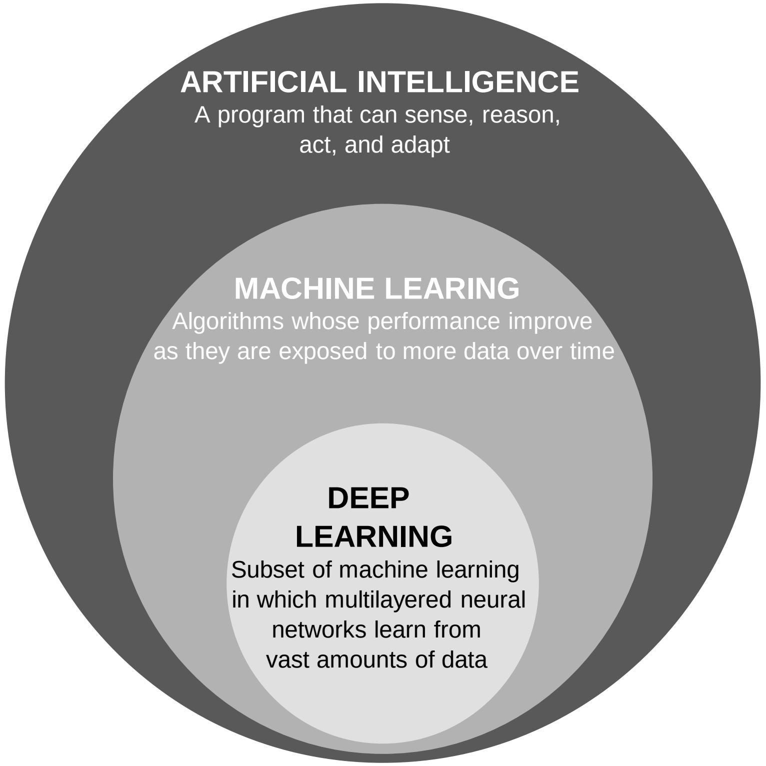


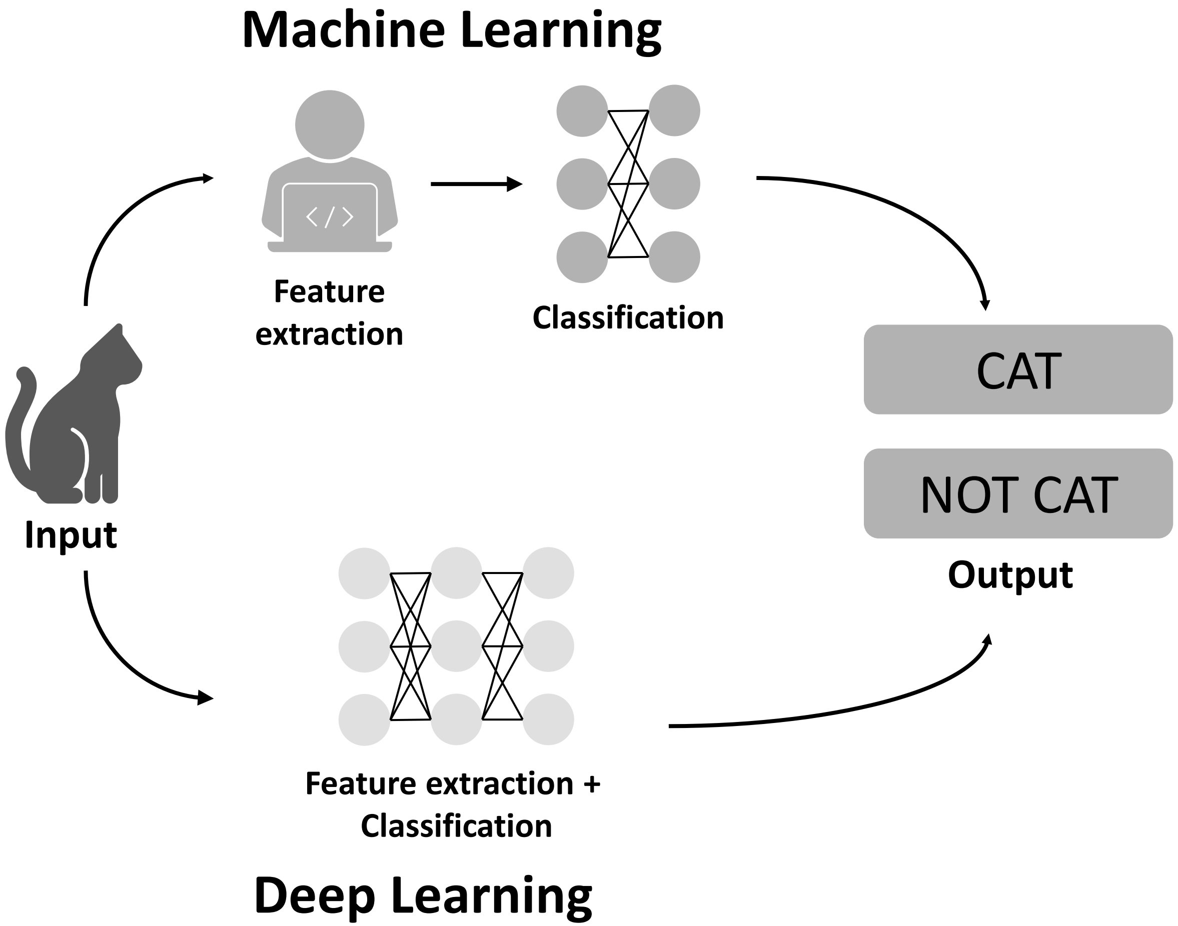
Quantitation

It is really confusing!!!



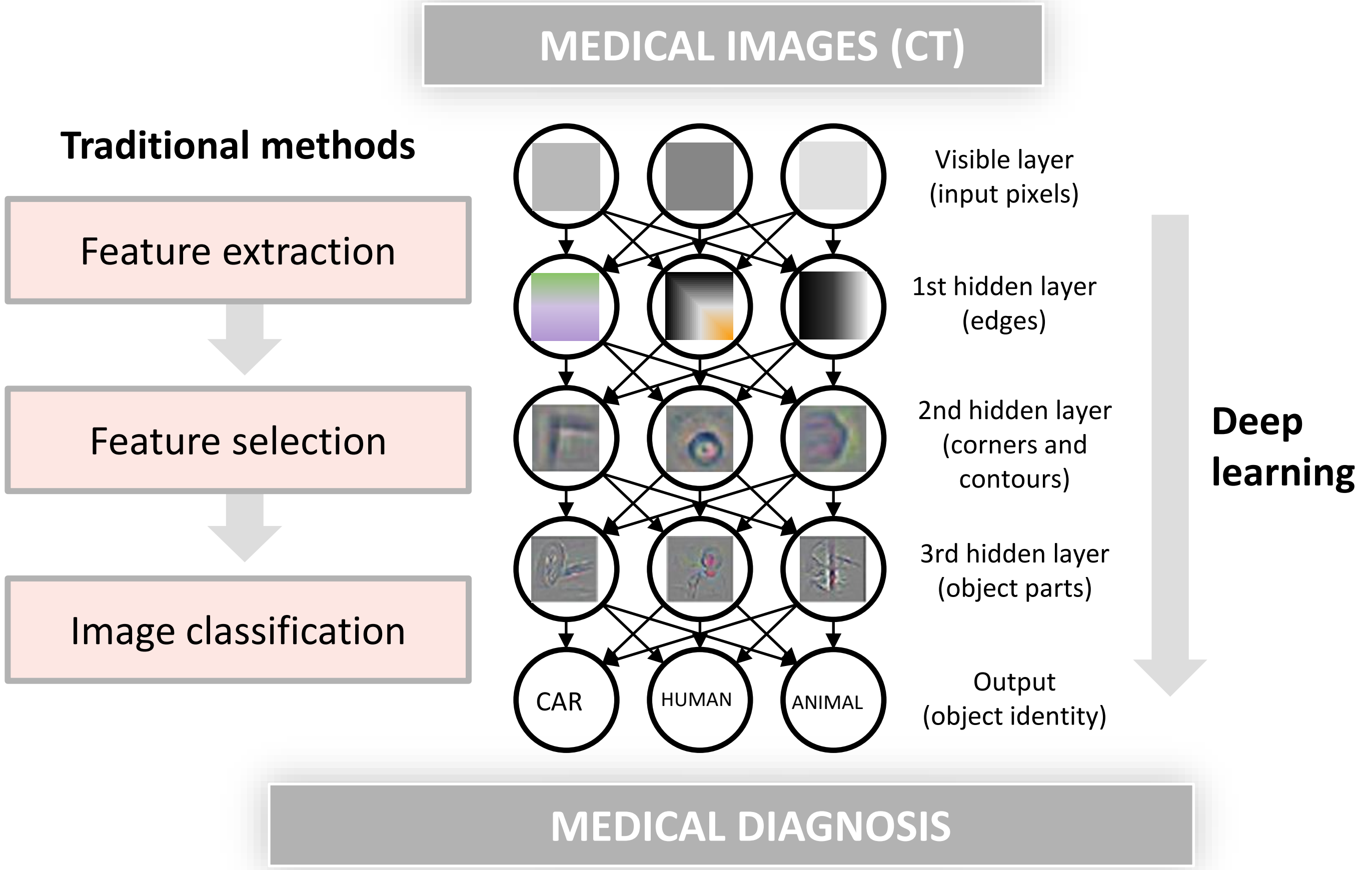
# ARTIFICIAL INTELLIGENCE, MACHINE LEARNING, AND DEEP LEARNING



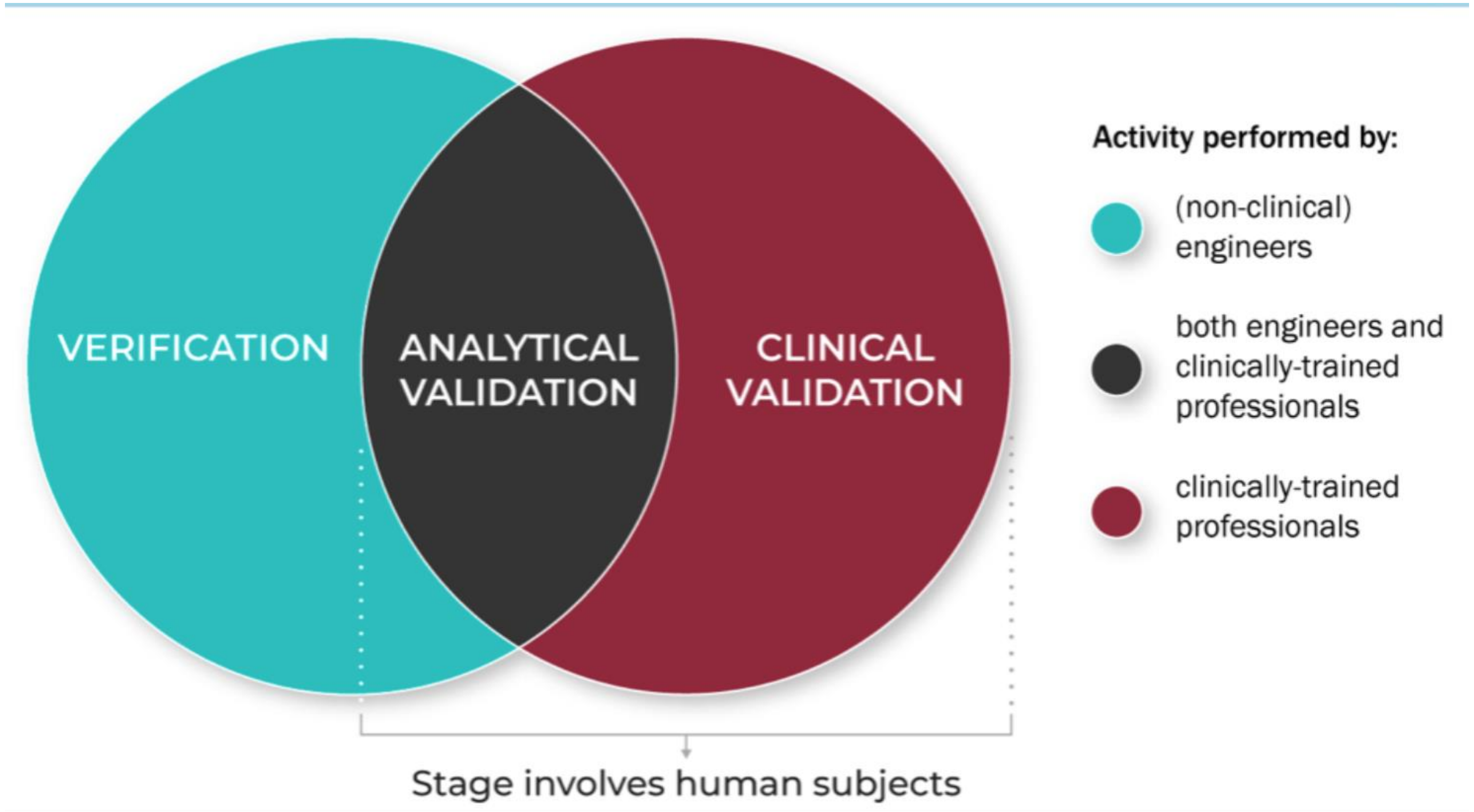



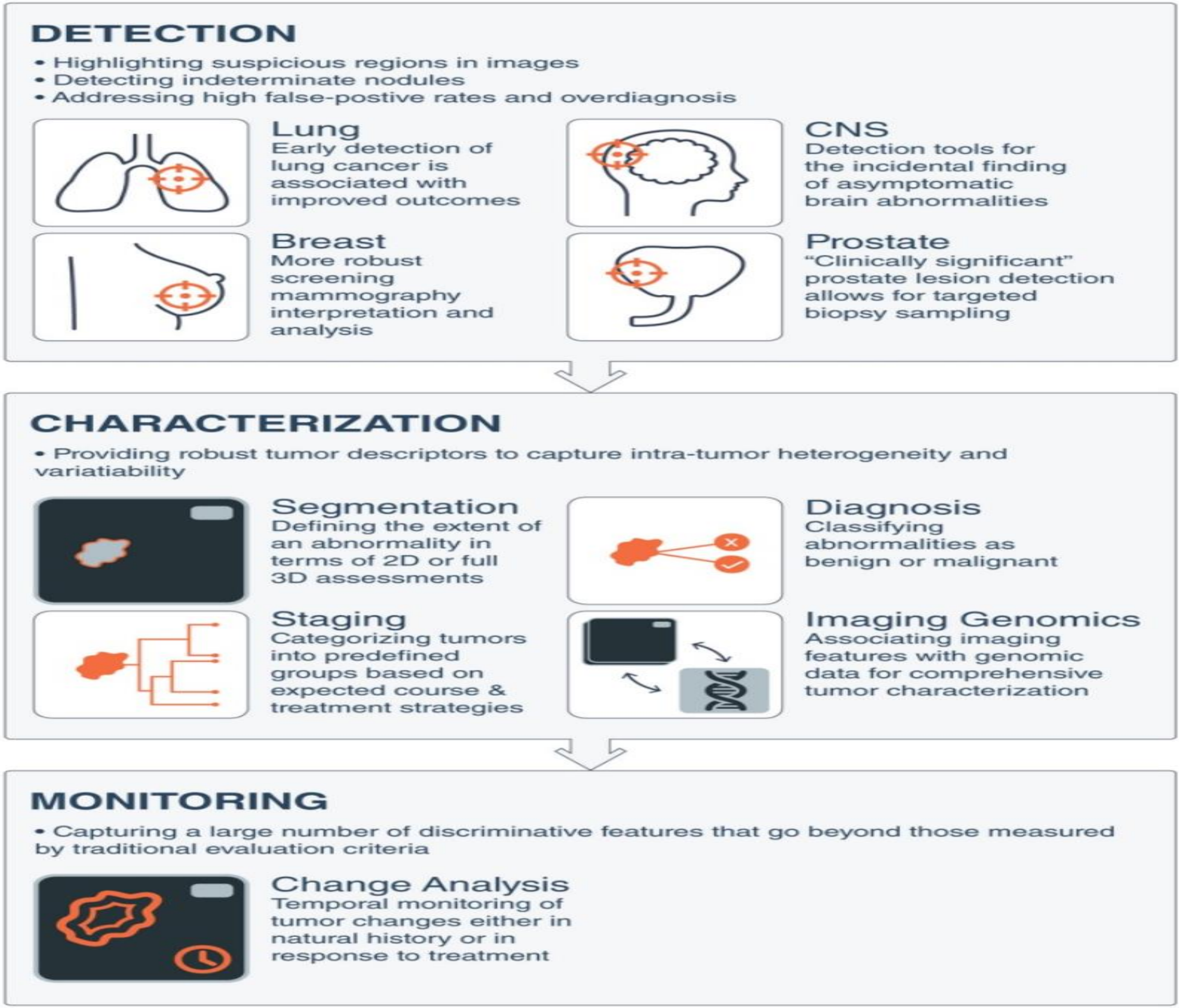
# DEEP LEARNING (DL) IN MEDICAL IMAGING

- Deep learning
  - "Deep": learning multiple levels of composition
  - a subset of machine learning methods that are based on neural networks to extract useful information from data

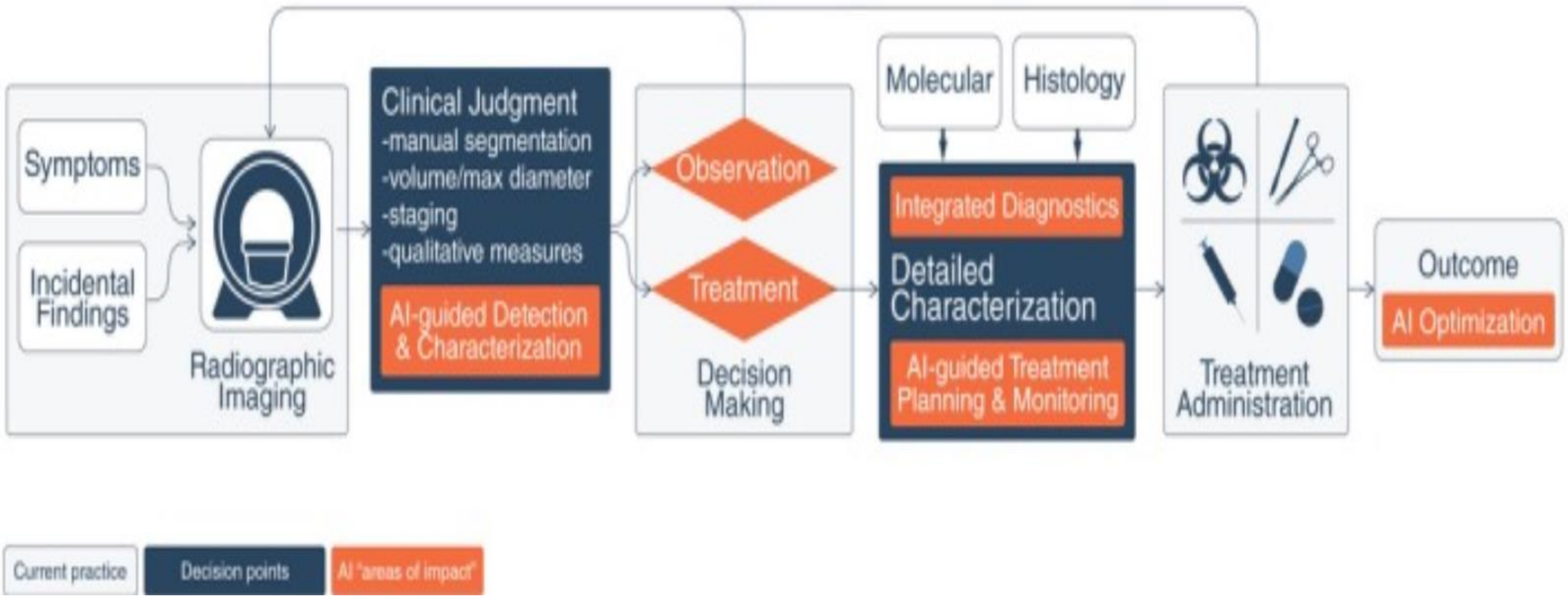


# Validation of AI






Bi WL, Artificial intelligence in cancer imaging: Clinical challenges and applications. *CA Cancer J Clin*. 2019;69(2):127-157. doi:10.3322/caac.21552


Symptoms
Incidental Findings
Radiographic Imaging
Clinical Judgment
-manual segmentation
-volume/max diameter
-staging
-qualitative measures
AI-guided Detection & Characterization
Observation
Treatment
Decision Making
Molecular
Histology
Integrated Diagnostics
Detailed Characterization
AI-guided Treatment Planning & Monitoring
Treatment Administration
Outcome
AI Optimization
Current practice
Decision points
AI "areas of impact"

# AI in Mammography:
# Improving Breast Health for All

Cheryce Poon Fischer, MD
Professor, Department of Radiology
Section Chief, Breast Imaging
UCLA – David Geffen School of Medicine

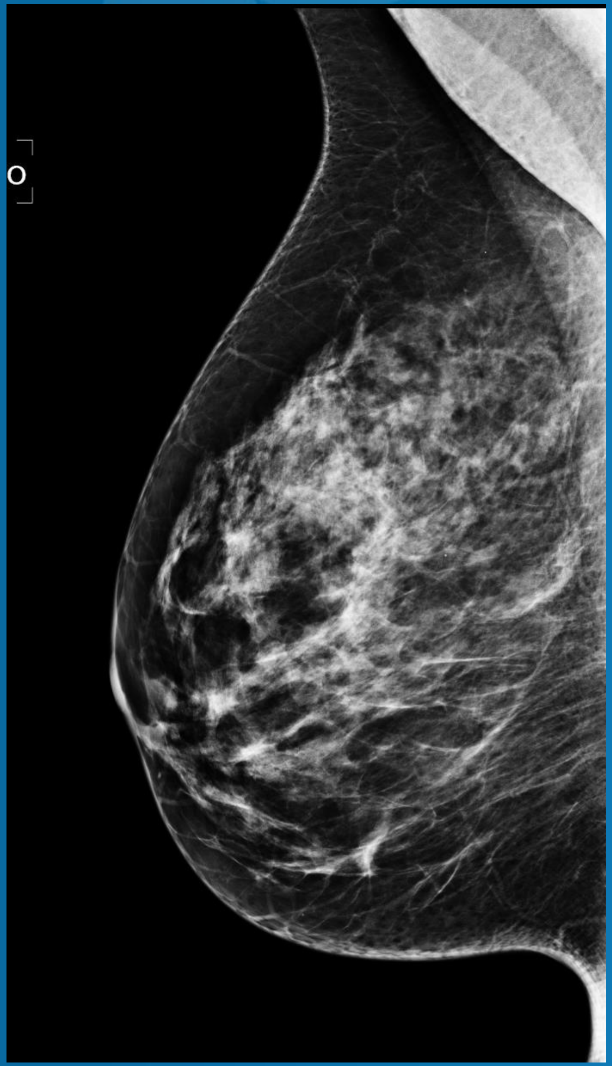
Exploring the role of Artificial Intelligence in mammography and its significance in detecting breast cancer, especially in women with dense breasts.

# The Importance of Mammography

- Mammography is the gold standard exam for early breast cancer detection
- Annual mammograms are recommended for women over 40 (recommend 3D if available)
- Detecting breast cancer early significantly increases survival rates

# What Are Dense Breasts?

- Breast tissue = fibroglandular tissue + fat
- Definition: Dense breast tissue contains more fibroglandular tissue than fatty tissue
- Dense breast tissue can make it harder to detect abnormalities on mammograms

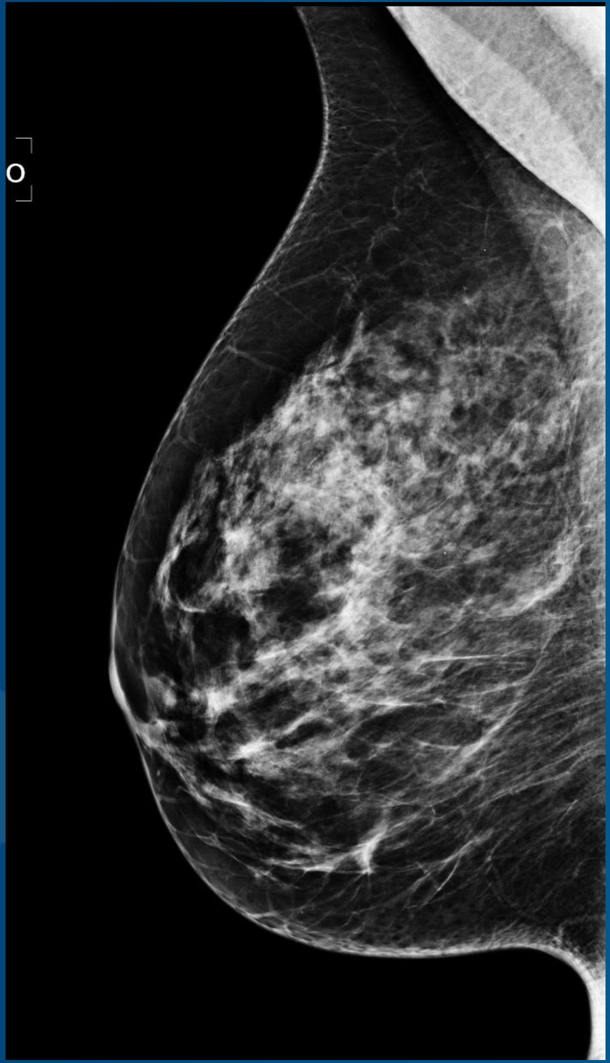


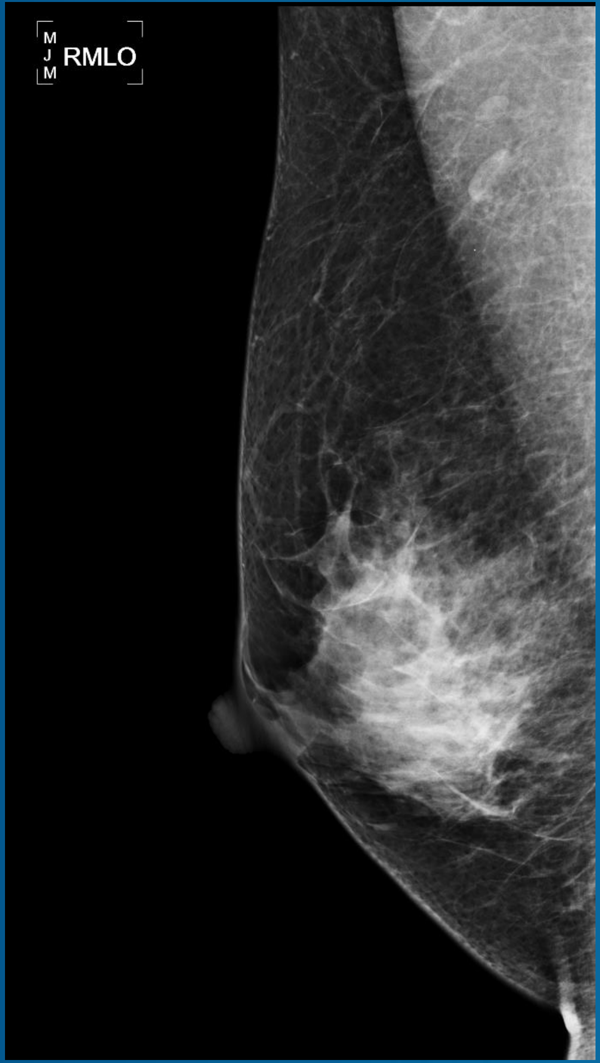
# What Are Dense Breasts?

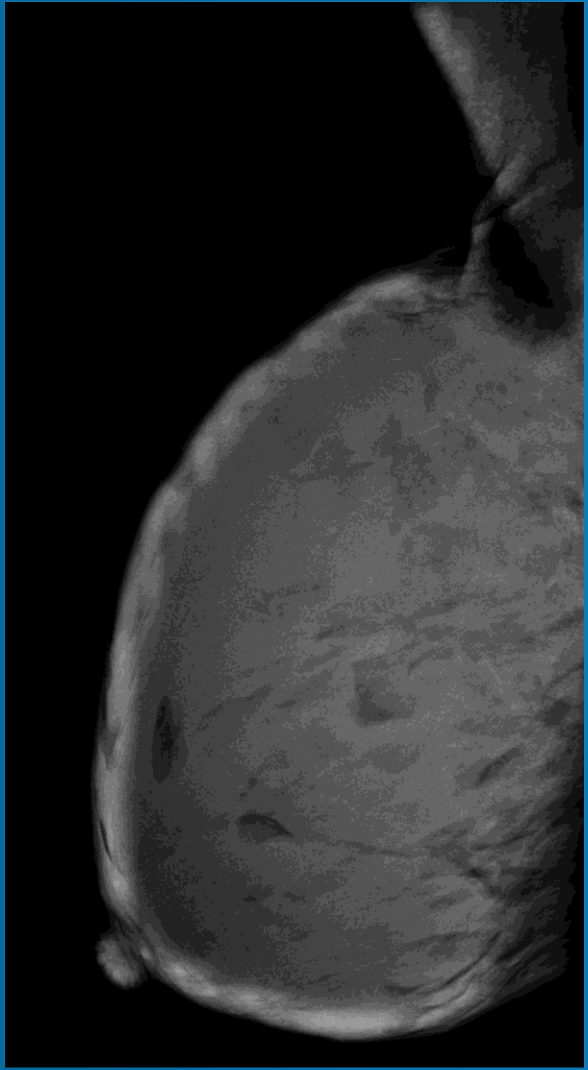
Dense breasts are normal and common

- Over 50% of premenopausal women have dense breasts
- 40% of women aged 50–59 have dense breasts
- 30% of women over age 60 have dense breasts

# Examples of Breast Density



# Mammography Challenges with Dense Breasts

- Dense breast tissue can obscure potential tumors
- Detection rates can be lower in dense breasts
- Traditional 2D mammography might not be as effective

**Table 2.** Current Supplemental Screening Guidelines in Addition to Annual Mammography Unless Otherwise Specified

| Population | ACS | NCCN[a] | ACR[a] | EUSOBI |
|---|---|---|---|---|
| Breast cancer risk assessment with genetic testing if appropriate | By the age of 30 years (31) | By the age of 25 years (47) | By the age of 25 years (50) | NS |
| Pathogenic mutation carrier or untested first-degree relative | Annual screening MRI starting at 25–30 years of age[b]; add annual mammography starting at 30 years (31) | Annual screening MRI age 25–30 years of age[b]; add annual mammography starting at 30 years (54) | Annual screening MRI age 25–30 years of age[b]; add annual mammography starting at age 40 years if annual MRI; 30 if not (50) | Annual MRI starting 5 years prior to age at diagnosis of youngest family member or by 30 years of age, whichever is earlier (53) |
| Lifetime risk of breast cancer ≥ 20%[c] | Annual MRI in addition to mammography starting by 30 years of age(31) | Annual MRI to begin 10 years prior to age at diagnosis of youngest family member, by 40 years of age, not before 30 years (47) | Annual screening MRI starting at 25–30 years of age; add annual mammography starting at 30 years of age (50) | Annual MRI starting 5 years prior to age at diagnosis of youngest family member or by 30 years of age, whichever is earlier (53) |
| Prior XRT overlapping breast tissue between 10 and 30 years of age | Annual MRI starting at 25 years of age or 8 years after XRT, whichever is later (31) | Annual MRI starting at 25 years of age or 8 years after XRT, whichever is later (47) | Annual MRI starting at 25 years of age or 8 years after XRT, whichever is later (50) | Annual MRI starting 5 years prior to age at diagnosis of youngest family member or by 30 years of age, whichever is earlier (53) |
| Personal history of breast cancer and dense breasts, treated conservatively, or diagnosis by 50 years of age | NS | Consider annual MRI[d] (79) | Annual MRI[d] (50) | NS |
| Personal history of breast cancer diagnosed >50 years of age, not dense | NS | NS | Consider annual MRI[d], especially if other risk factors are present (50) | NS |
| Personal history of LCIS or atypical biopsy | NS | Consider annual MRI to begin at diagnosis of LCIS/ADH but not prior to 25 years of age (47) | Consider annual MRI, especially if other risk factors are present (50) | NS |
| **For Women Attending Regular Screening Mammography, Not Previously Identified as High Risk** | | | | |
| Extremely dense breasts without other risks | NS | NS | Annual MRI[a] (50,51) | MRI every 2–4 years; US when MRI not possible (52) |
| Extremely dense breasts plus any of the following[e]: (1) First-degree relative with breast cancer at any age (2) Two second-degree relatives from the same side of the family with breast cancer at any age (3) Prior benign biopsy with proliferative change[f] | Annual MRI as lifetime risk ≥20%[c] | Annual MRI, as lifetime risk ≥20%, to begin 10 years prior to the age at diagnosis of youngest family member, by 40 years of age, not before 30 years (as applicable) (47) | Annual MRI[a] due to extremely dense breasts, independent of other risk factors (50,51) | Annual MRI as lifetime risk ≥20%, starting 5 years prior to age at diagnosis of youngest family member or by 30 years of age, whichever is earlier (53) |

**Table 2.** Continued

| Population | ACS | NCCN[a] | ACR[a] | EUSOBI |
|---|---|---|---|---|
| Heterogeneously dense breasts plus any of the following[e]: (1) First- or second-degree relative with breast cancer at any age and prior benign biopsy with proliferative change[f] (2) ≥2 relatives from the same side of the family with breast cancer, diagnosis by 50 years of age | Annual MRI as lifetime risk ≥20%[c] | Annual MRI, as lifetime risk ≥20%, to begin 10 years prior to the age at diagnosis of youngest family member, by 40 years of age, not before 30 years (47) | Annual MRI as lifetime risk ≥20% (50,51) | Annual MRI as lifetime risk ≥20%, starting 5 years prior to age at diagnosis of youngest family member or by 30 years of age, whichever is earlier (53) |
| Heterogeneously dense breasts without other risks | NS | NS | MRI or CEM may be appropriate; US may be appropriate (disagreement) (51) | Possible US (80) |

Abbreviations: ACOG, American College of Obstetricians and Gynecologists; ACR, American College of Radiology; ACS, American Cancer Society; ADH, atypical ductal hyperplasia; CEM, contrast-enhanced mammography; EUSOBI, European Society of Breast Imaging; LCIS, lobular carcinoma in situ; NCCN, National Comprehensive Cancer Network; NS, not stated; XRT, chest radiation therapy.

[a]NCCN and ACR recommend CEM or US for women in whom MRI is recommended but not able to be performed.

[b]Details vary by specific mutation.

[c]Lifetime risk of ≥20% by at least one of the risk models based largely on family history including second-degree relatives (such as the Tyrer-Cuzick, Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm, or BRCAPRO models, but not the Gail model).

[d]NCCN and ACR also recommend MRI be considered for individuals "whose lifetime risk of a second primary breast cancer is >20% based on models largely dependent on family history, such as in those with the risk associated with inherited susceptibility to breast cancer."

[e]The vast majority of women aged 40 years or over attending regular screening mammography meeting these criteria will have a lifetime risk of ≥20% by at least one of the risk models based largely on family history including second-degree relatives (such as the Tyrer-Cuzick, [IBIS] Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm, or BRCAPRO models, but not the Gail model); before the age of 40 years, additional women may also meet the 20% lifetime risk threshold based on these or other risk factors.

[f]Usual ductal hyperplasia, papilloma, adenosis or sclerosing adenosis, radial scar.

# Introduction to AI in Mammography

- Artificial Intelligence (AI) is revolutionizing healthcare

- What is AI?

AI in mammography refers to the use of computers to assist radiologists in interpreting mammograms

AI systems are trained on vast datasets of mammograms to recognize patterns and abnormalities in breast tissue. These algorithms can detect subtle changes that might be indicative of breast cancer, even in cases of dense breast tissue, where cancer can be more challenging to identify

# How AI Works in Mammography

- AI analyzes mammogram images for abnormalities
- AI highlights suspicious areas for further review
- AI can learn from large datasets to enhance accuracy

# Benefits of AI in Mammography

- Improved sensitivity and accuracy in detecting breast cancer.
- Reduced false positives (unnecessary biopsies, recalls or follow ups)
- Reduce false negatives (early cancers)
- Enhanced early detection in dense breasts

# Summary of AI in Mammography

- The main goal of AI in mammography is to improve the accuracy, efficiency, and early detection of breast cancer while reducing the occurrence of false positives and false negatives
- By aiding healthcare providers in interpreting mammograms, AI can enhance the overall quality of breast cancer screening and contribute to better outcomes for patients
- <u>However, it's important to note that AI in mammography is designed to assist radiologists, not replace them, and human oversight remains a crucial part of the diagnostic process</u>

# Regulation and Safety

- The FDA approves AI applications in medical imaging
- Ongoing monitoring and updates are essential

# Future of AI in Mammography

- AI technology is continually improving
- Integration with other programs (risk assessment, breast density)
- AI in mammography will be a valuable tool in improving breast cancer detection, particularly in women with dense breasts

# Thank you!

# Artificial Intelligence and Breast Cancer

## Sharsheret Webinar
## October 30, 2023

Hannah Milch, MD

Assistant Professor

Breast Imaging

Department of Radiological Sciences at UCLA

# Three Roles of AI in Breast Imaging

1. Improve breast cancer screening performance
   - Detection, false positives
2. Risk assessment
   - Breast density, lifetime risk
3. Workflow
   - Scheduling, efficiency, patient/provider tools

# Using AI to help radiologist interpret a screening mammogram

10


> 87 % of cancers are in this category

9 - 8


6/1000

7 - 0


99.97 % of screening exams are negative

# AI score report


**Category 1**
finding > 75
Elevated Risk

**Category 2**
finding 43-74
Intermediate Risk

**Category 3**
finding < 43
Low Risk

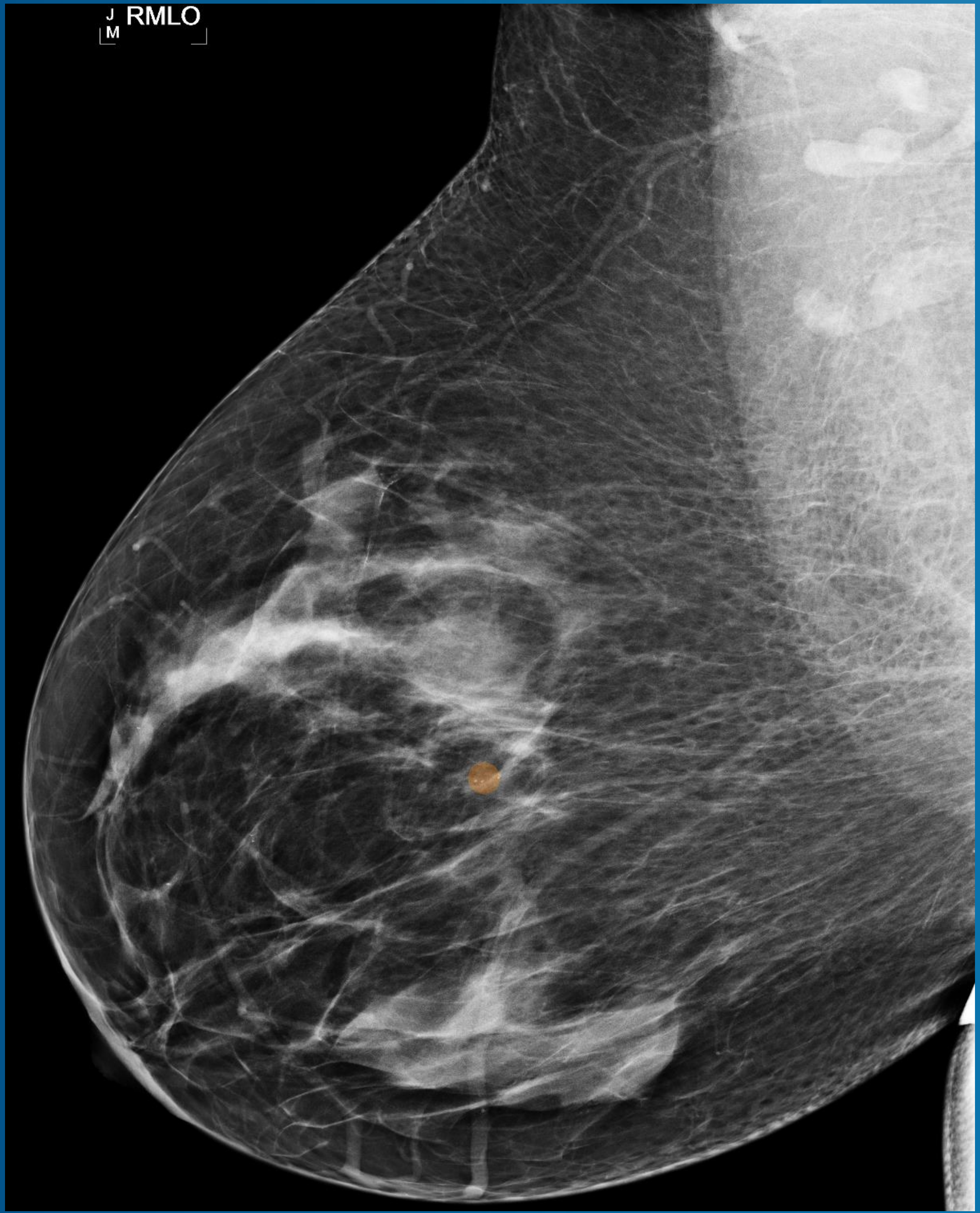
# External Validation of AI system at UCLA

## 3D/DBT Cohort of 2,977 screening exams with 58 cancers

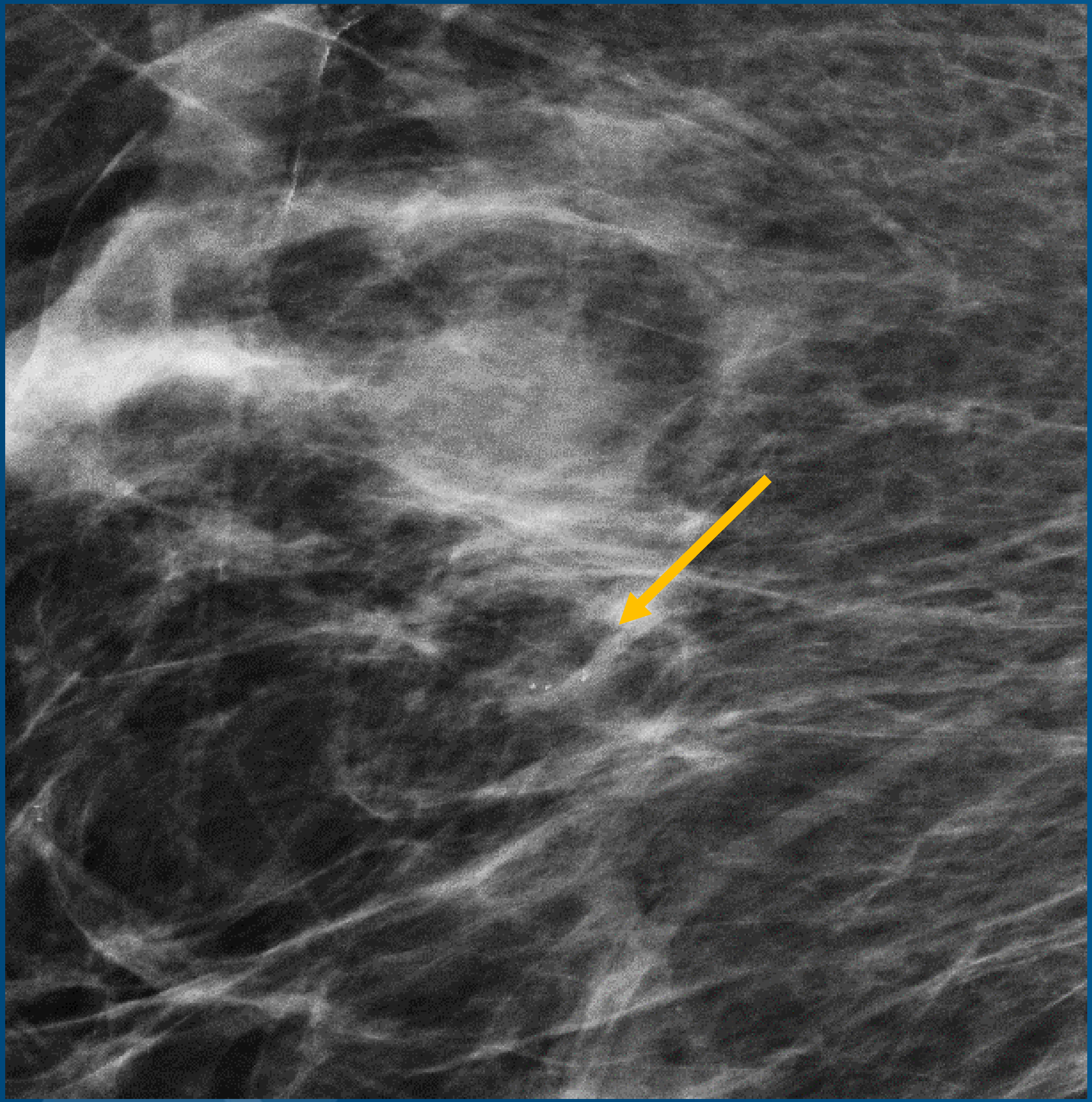
| | AI | Radiologist |
|---|---|---|
| **Recall Rate** | **11.3%** | **11.7%** |
| **Sensitivity** | 72.4% | 77.6% |
| **Specificity** | 89.8% | 89.5% |
| **NPV** | 99.6% | 99.5% |

**Question re: ILC. AI flagged 50% of mammograms with lobular cancers not detected by radiologist (vs 75% of invasive ductal cancers)**

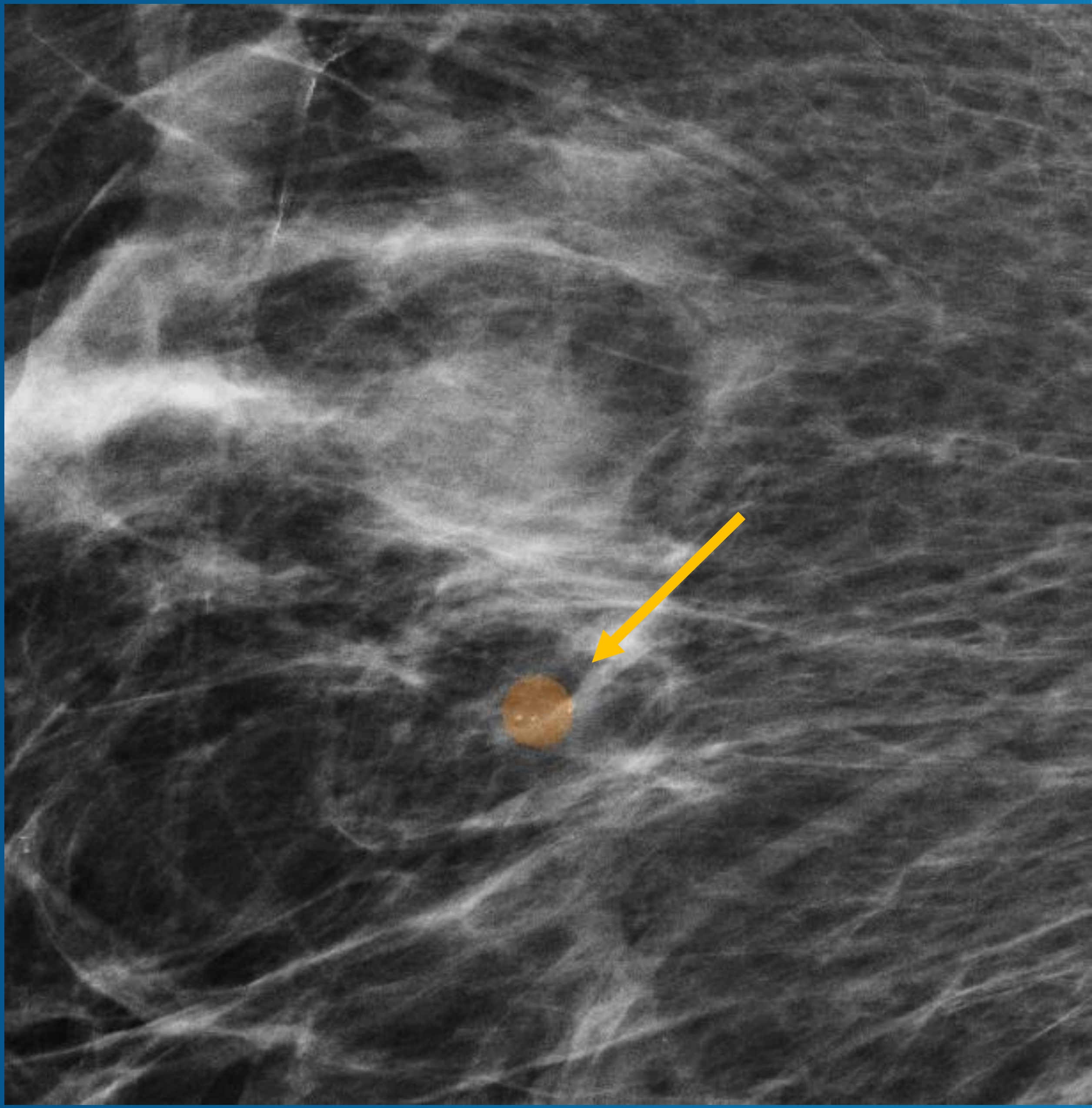

Screening Mammogram without AI




Screening Mammogram with AI (orange circle)

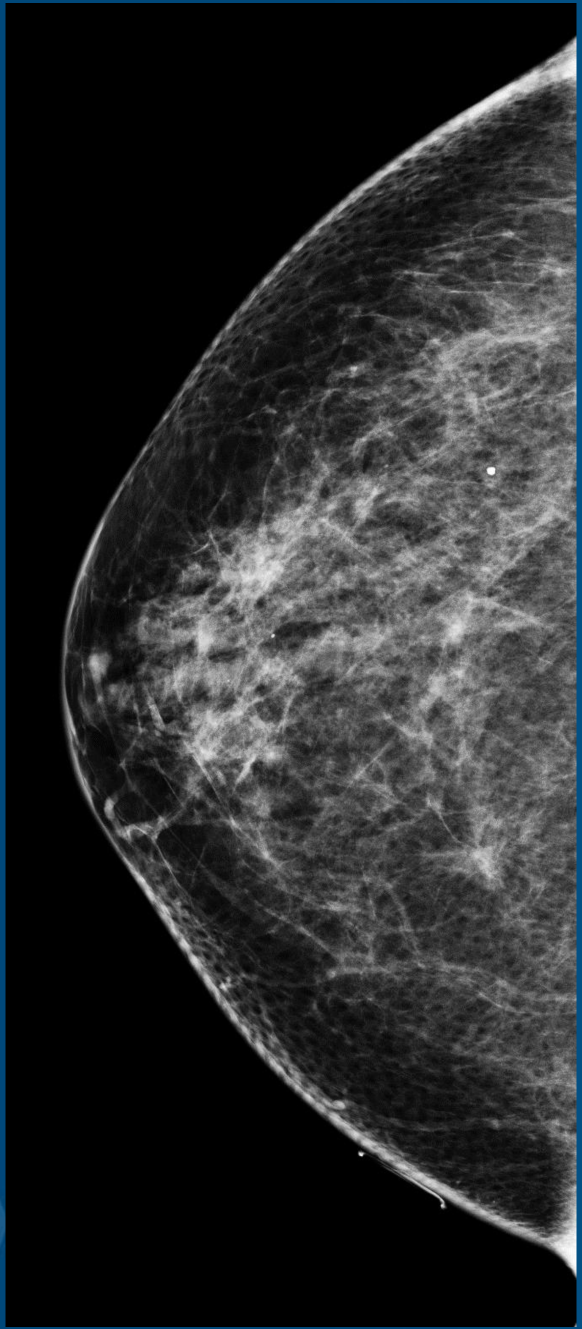


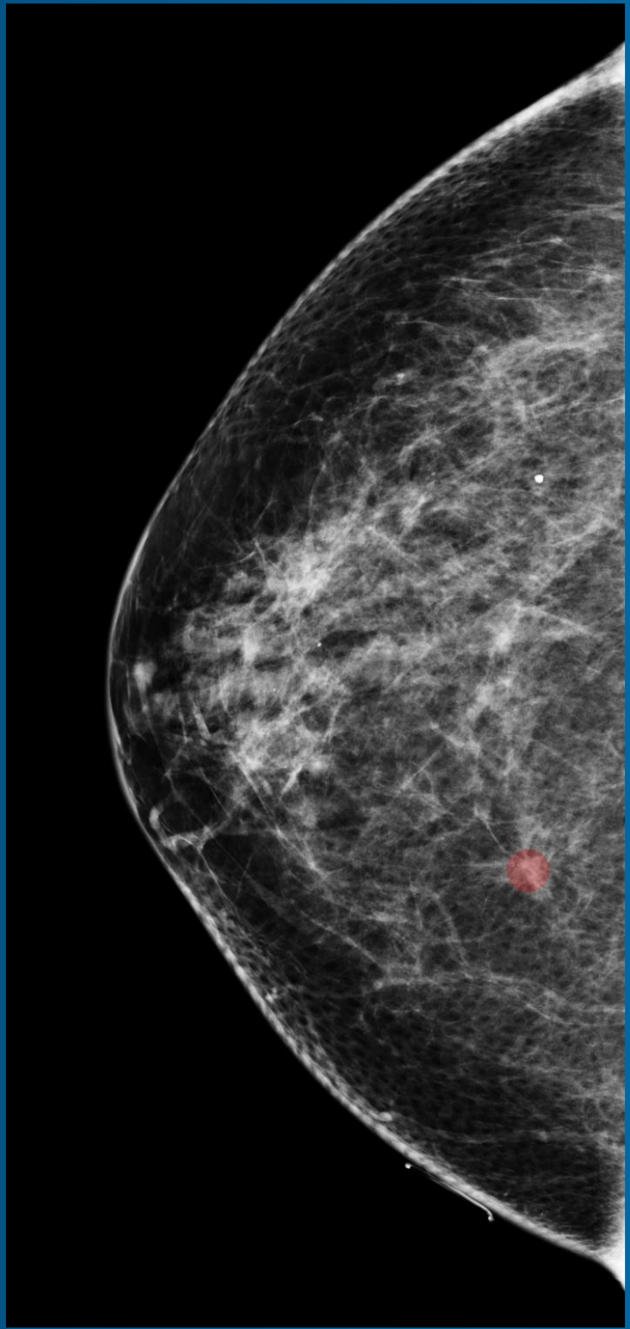
Screening Mammogram without AI



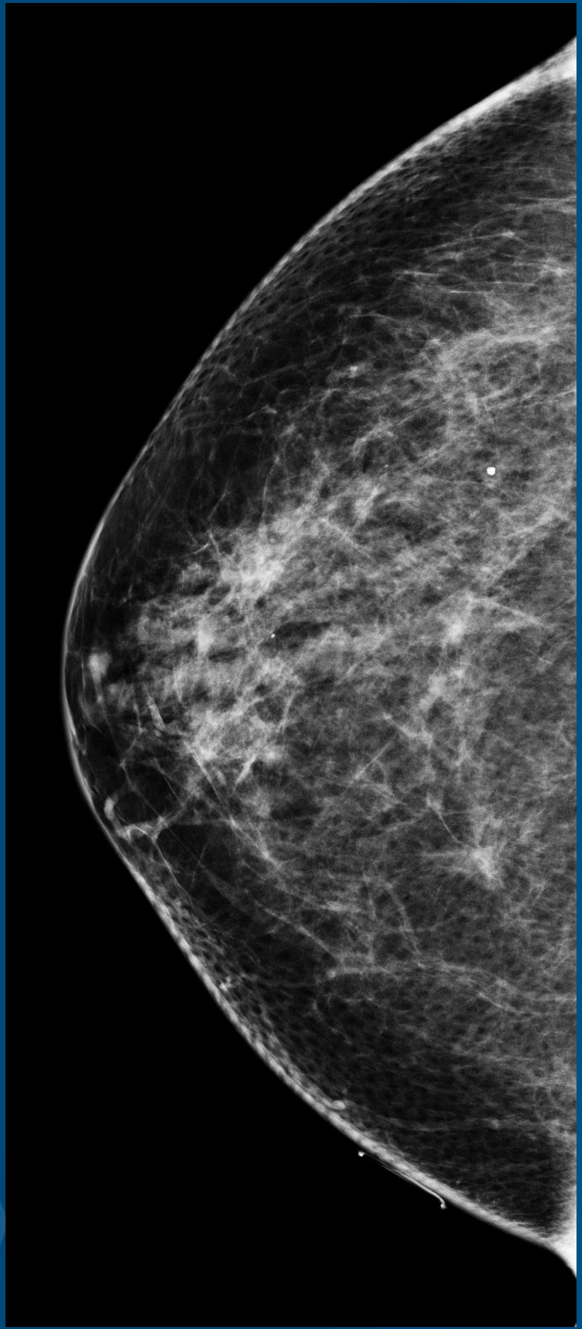
Screening Mammogram with AI (orange circle)

UCLA David Geffen School of Medicine


Screening Mammogram without AI


Screening Mammogram with AI (red circle)

UCLA David Geffen School of Medicine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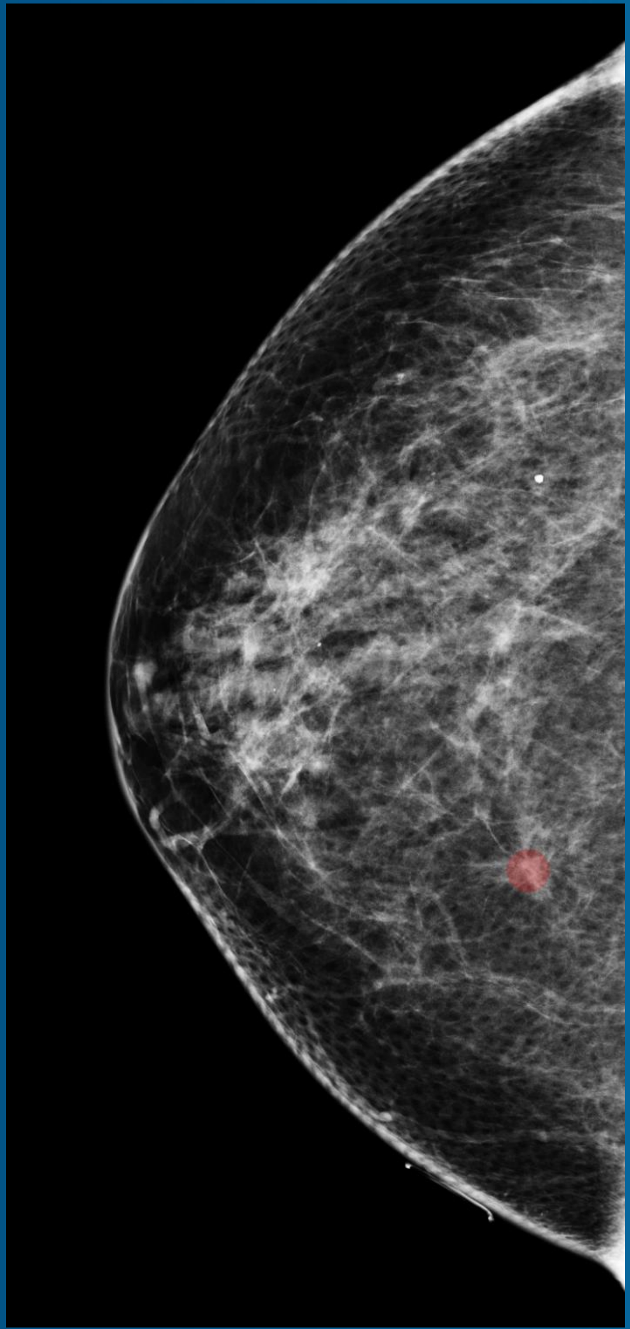
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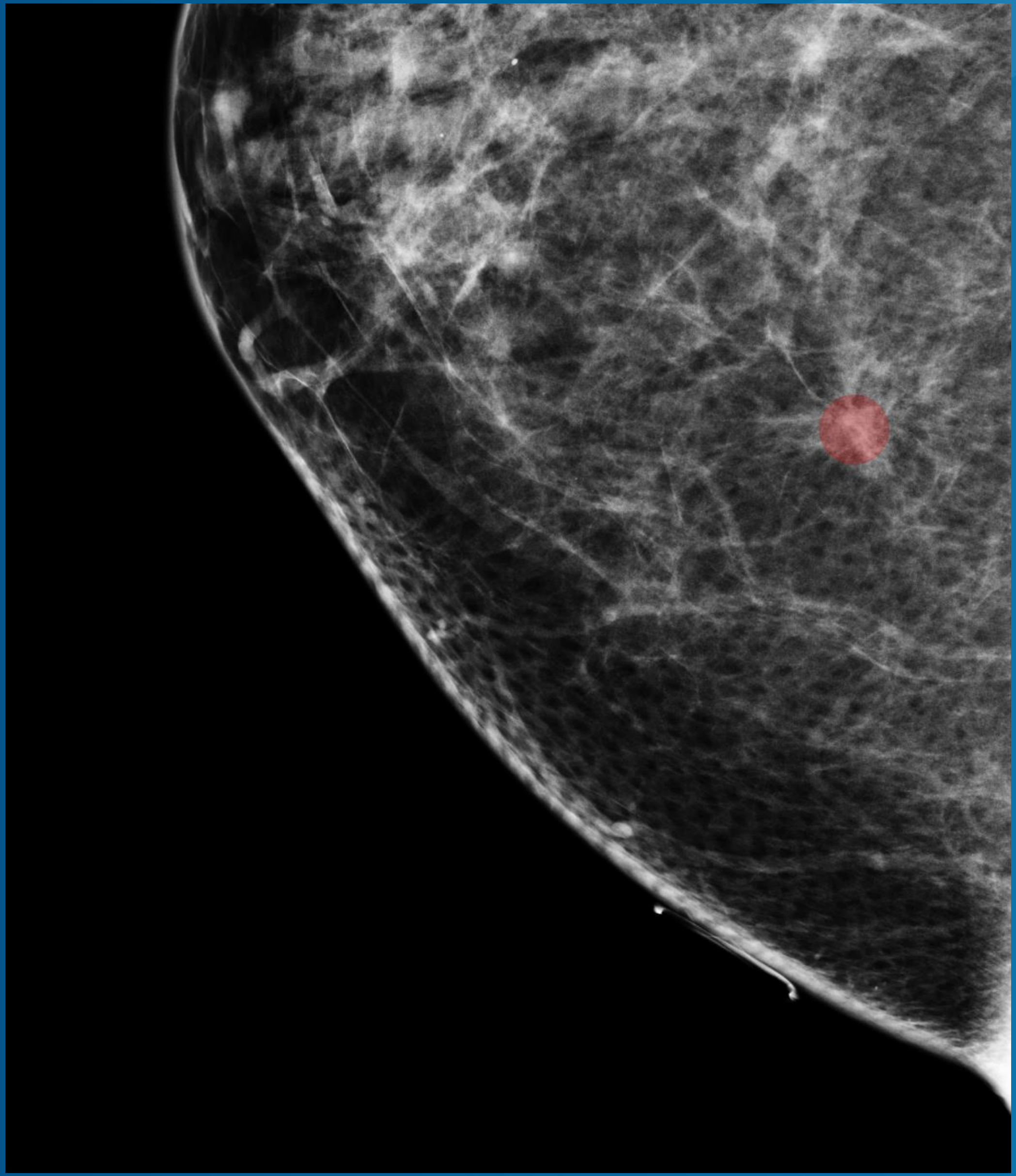
Screening Mammogram without AI



Screening Mammogram with AI (red circle)

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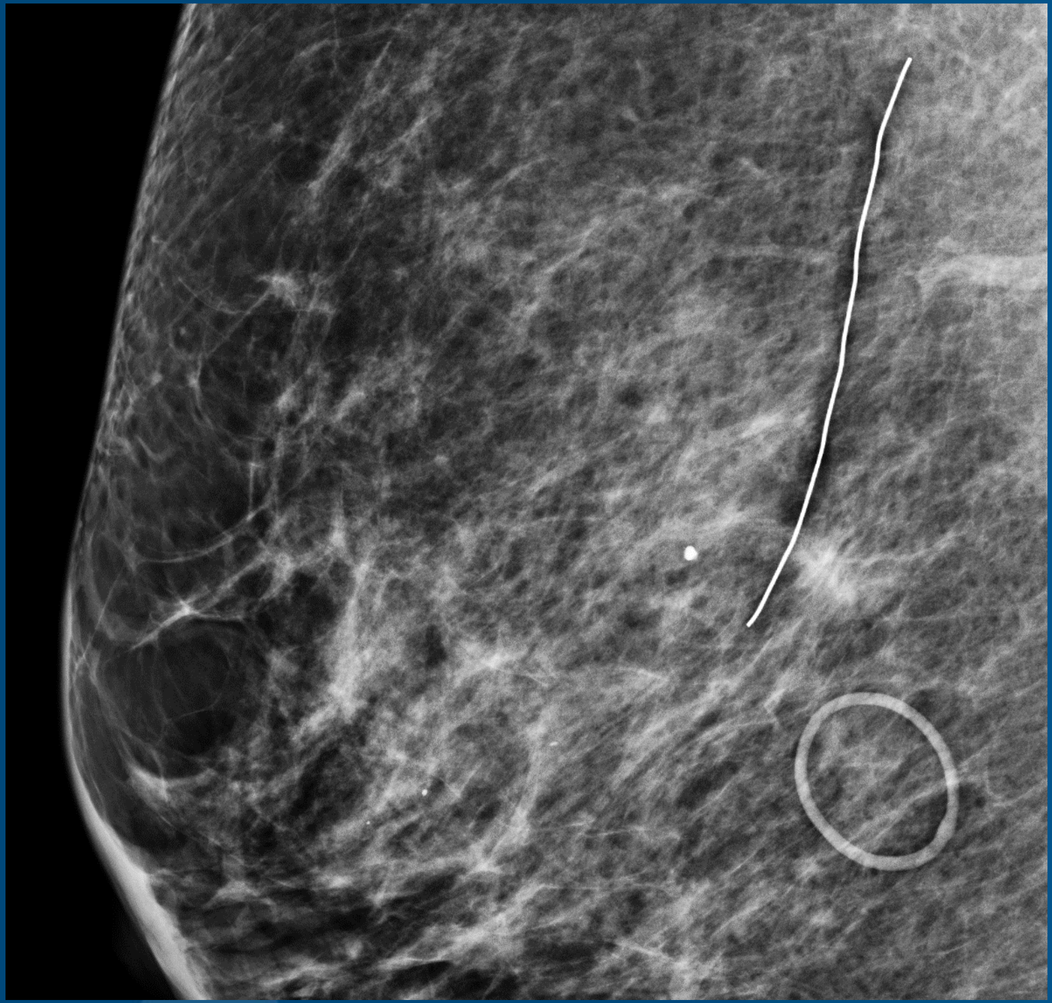
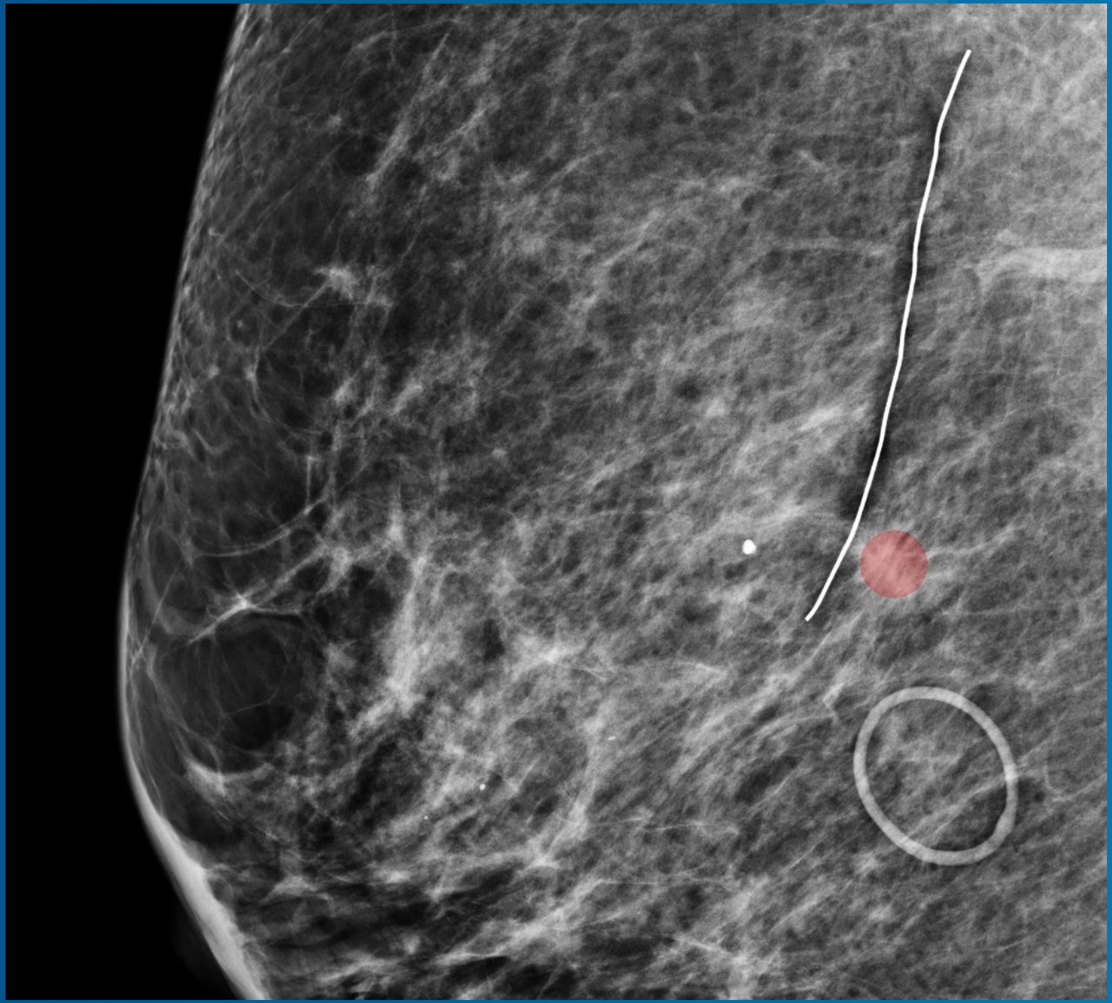
Screening Mammogram without AI

Screening Mammogram with AI (red circle)

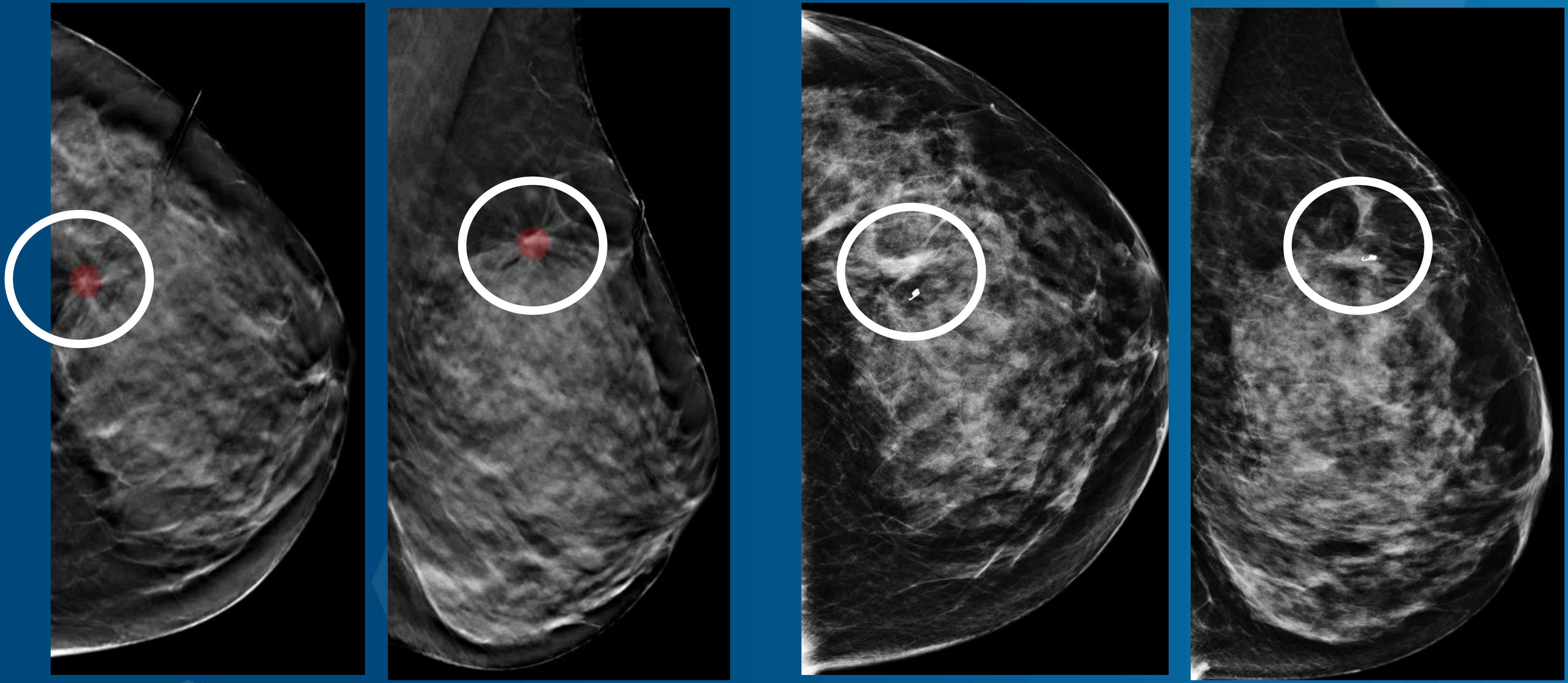
UCLA David Geffen School of Medicine

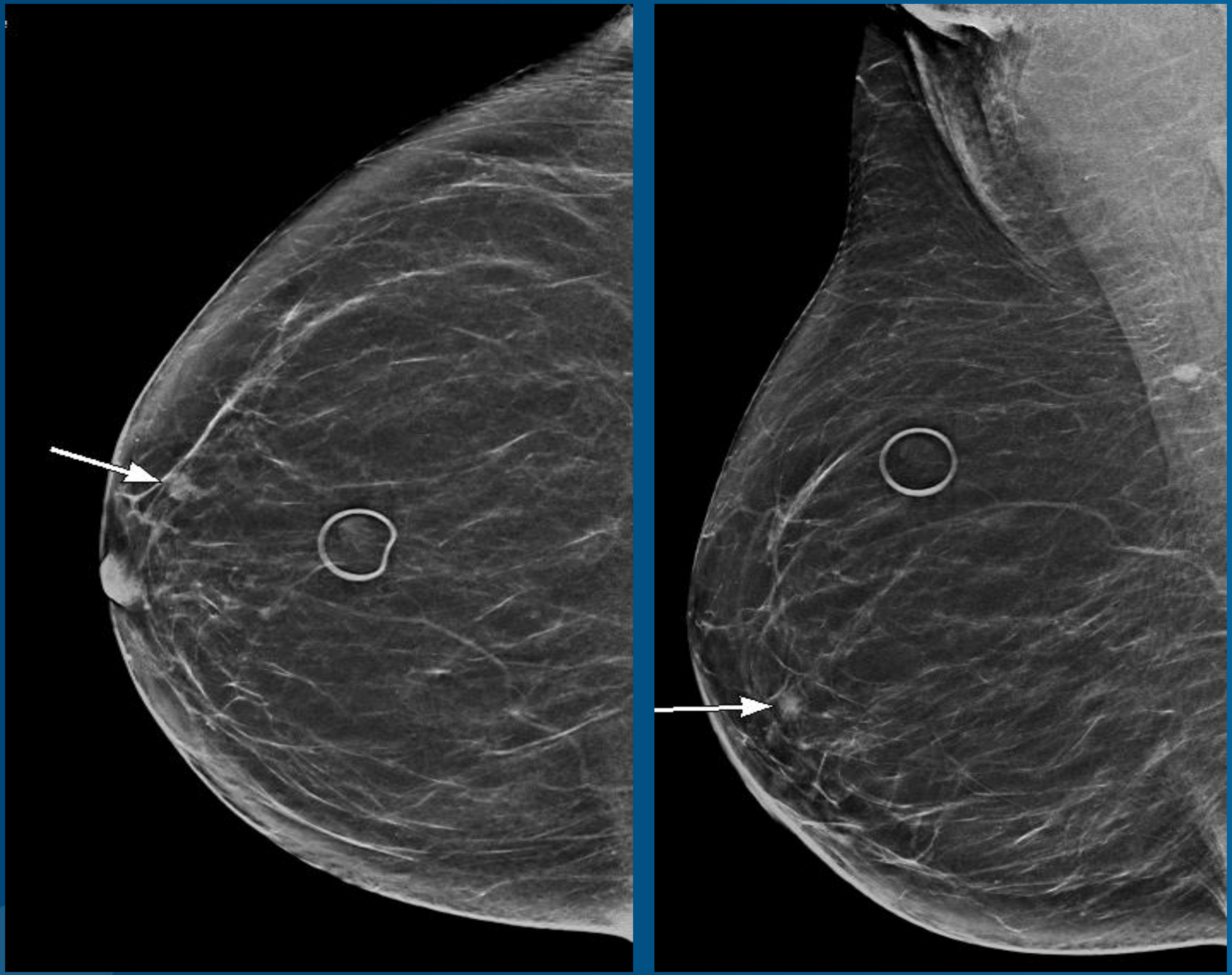


Screening Mammogram without AI



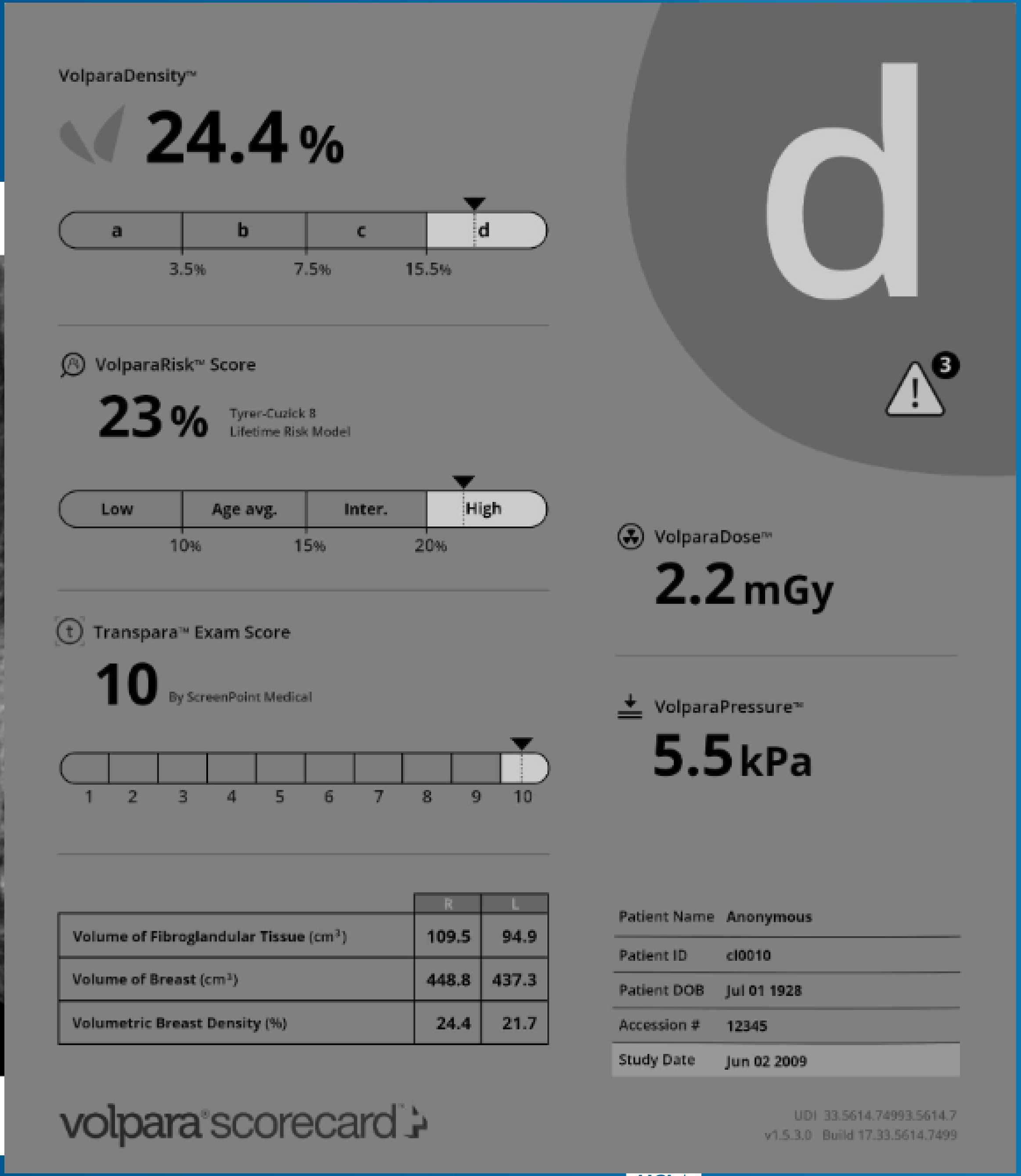
Screening Mammogram with AI (red circle)





Limitations of AI
-Screening Mammogram read as negative by AI

# AI and Breast Density

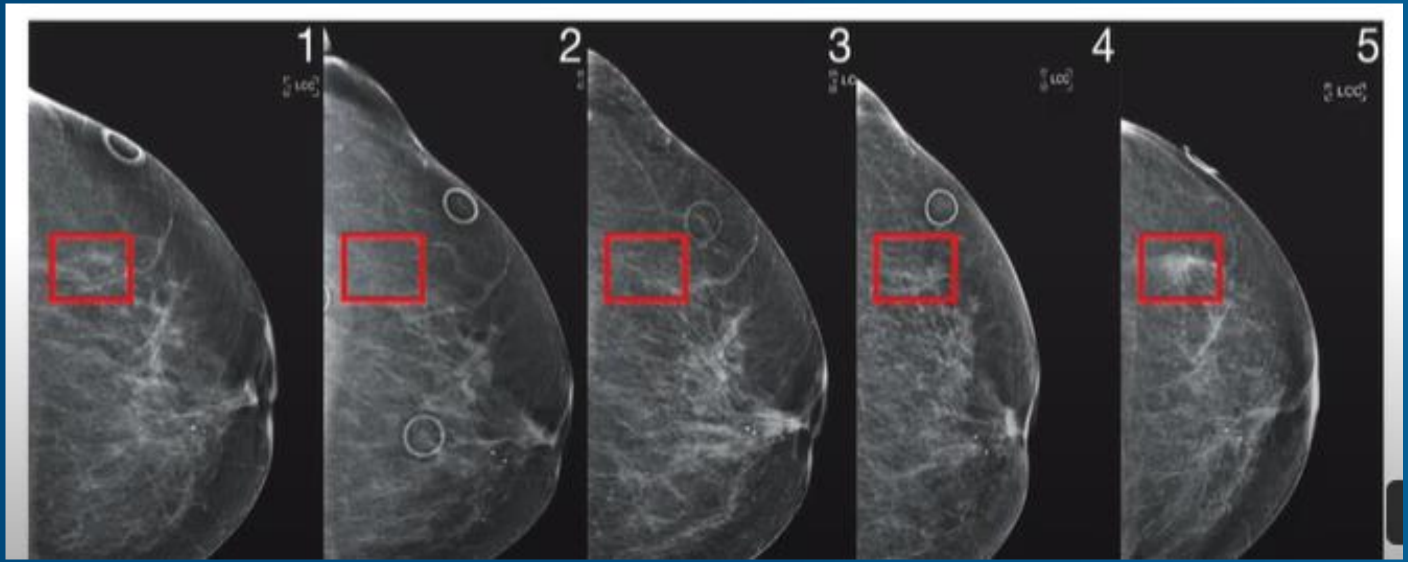



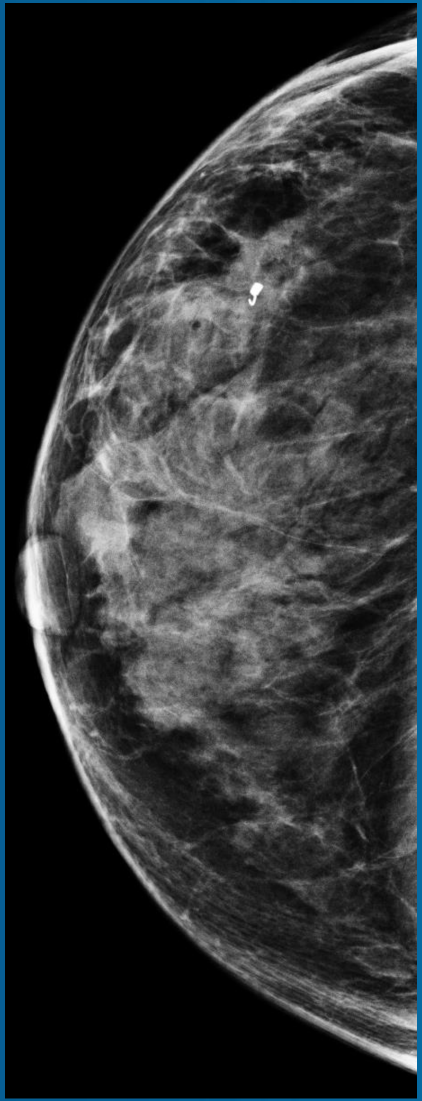
# Risk Models

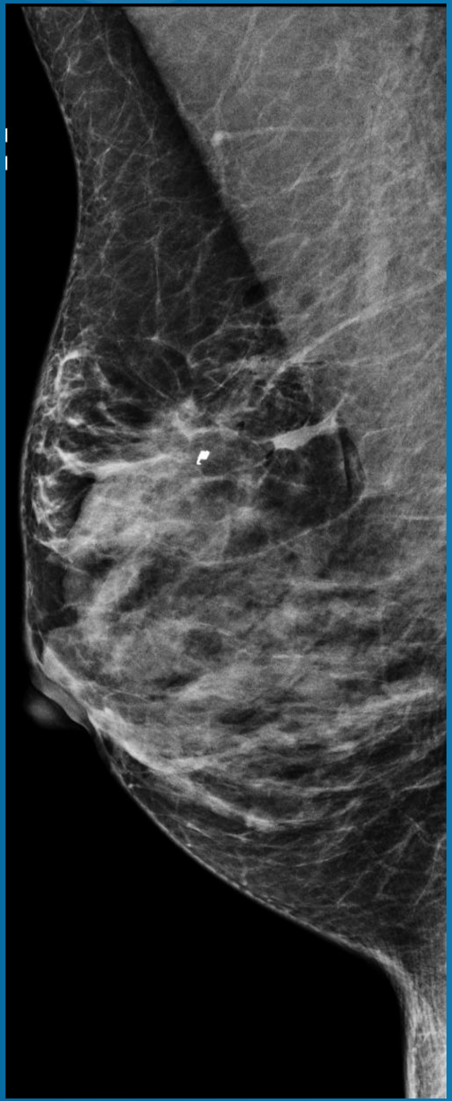
| Variables | Gail | Claus | Tyrer-Cuzick |
|---|---|---|---|
| **Personal information** | | | |
| Age | Yes | Yes | Yes |
| Body mass index | No | No | Yes |
| **Hormonal factors** | | | |
| Menarche | Yes | No | Yes |
| First live birth | Yes | No | Yes |
| Menopause | No | No | Yes |
| **Personal breast disease** | | | |
| Breast biopsies | Yes | No | Yes |
| Atypical hyperplasia | Yes | No | Yes |
| LCIS | No | No | Yes |
| **Family history** | | | |
| First degree relatives | Yes | Yes | Yes |
| Second degree relatives | No | Yes | Yes |
| Age of onset of cancer | No | Yes | Yes |
| Bilateral breast cancer | No | No | Yes |
| Ovarian cancer | No | No | Yes |
| Male breast cancer | No | No | No |

LCIS: Lobular carcinoma in situ, TC: Tyrer-Cuzick

# AI Risk Assessment- A picture is worth a thousand words





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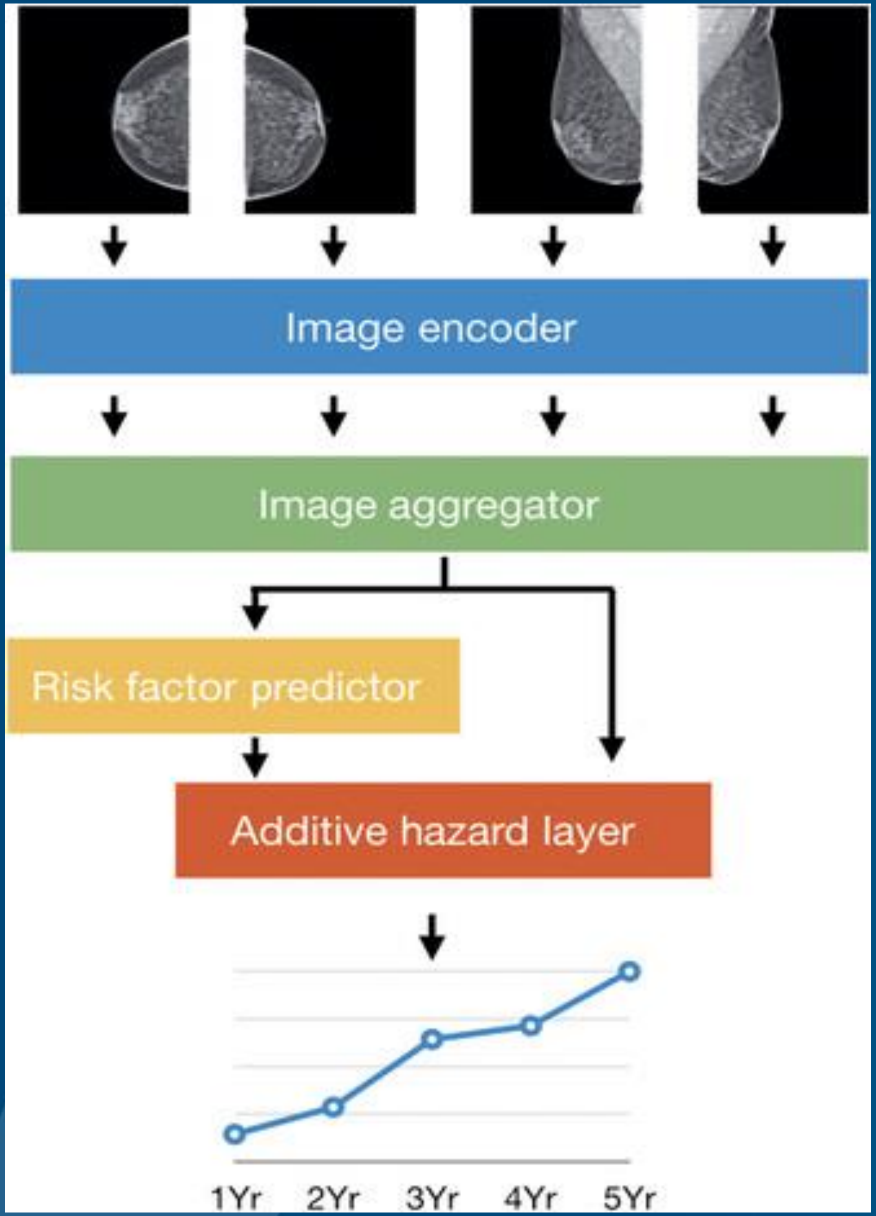



- Predicts breast cancer risk each year over the next five years based on 4 mammographic views
- Outperforms traditional models
- Performs similarly across different races, ages and breast densities
- Breast cancer survivors: improved and more uniform risk assessment models

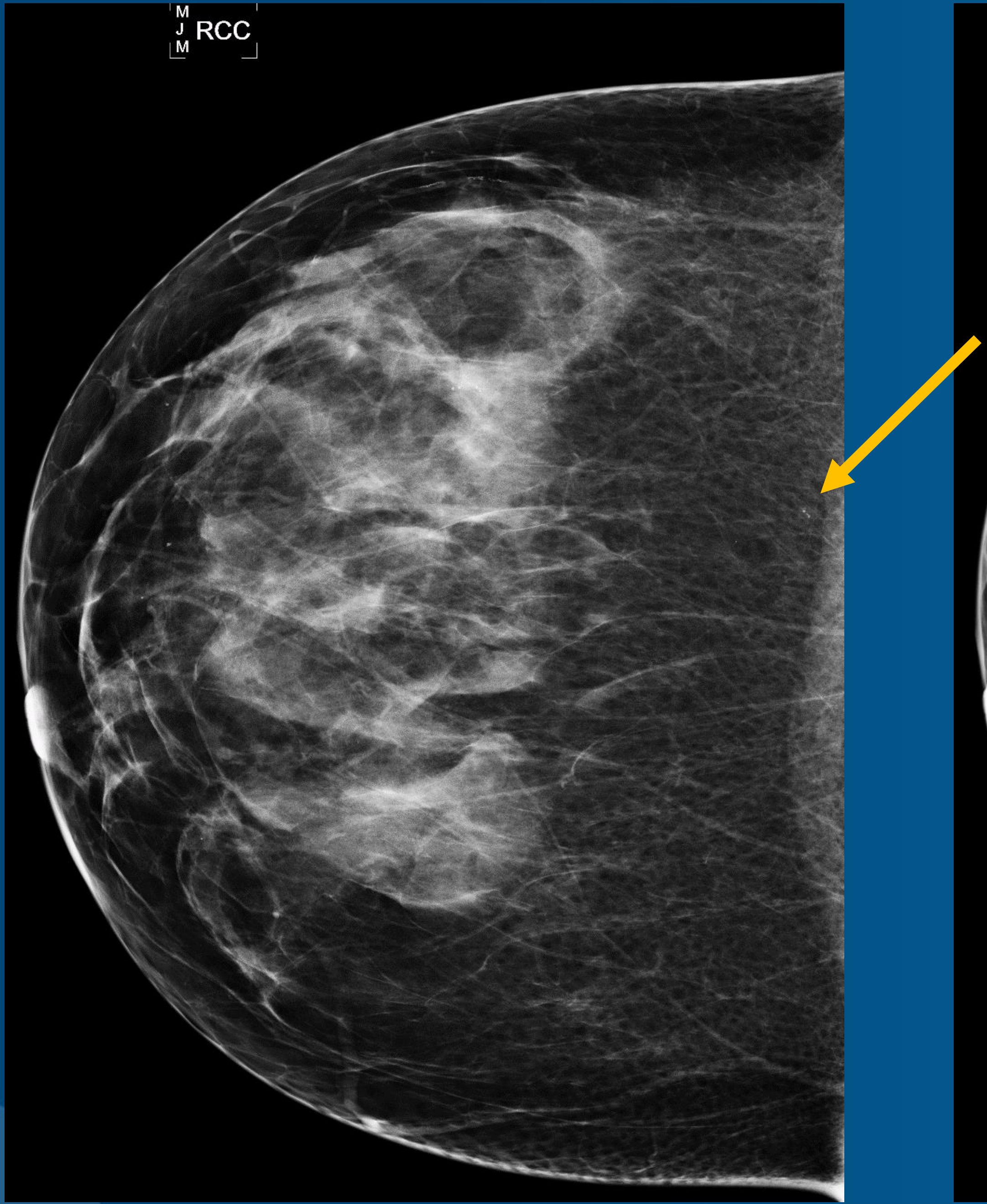
UCLA David Geffen School of Medicine

Toward robust mammography-based models for breast cancer risk, Volume: 13, Issue: 578, DOI: (10.1126/scitranslmed.aba4373

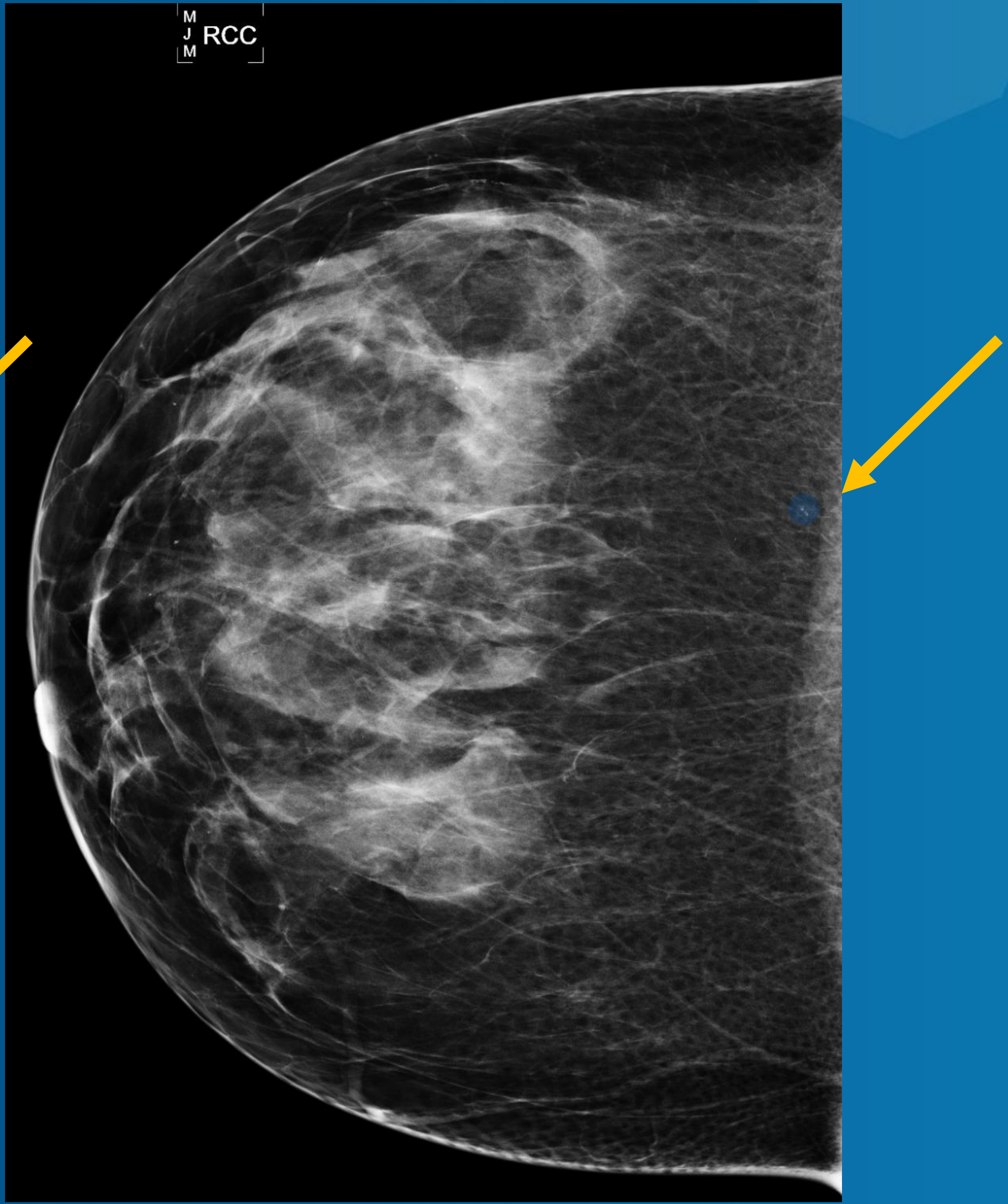
# Conclusion

- Three important ways AI can improve breast cancer screening
    - Accuracy (cancer detection, false positives)
    - Risk assessment
    - Workflow
- We are not there yet
    - Need prospective real-world studies to determine true benefits of AI

# Thank You




Screening Mammogram without AI




Screening Mammogram with AI (blue circle)

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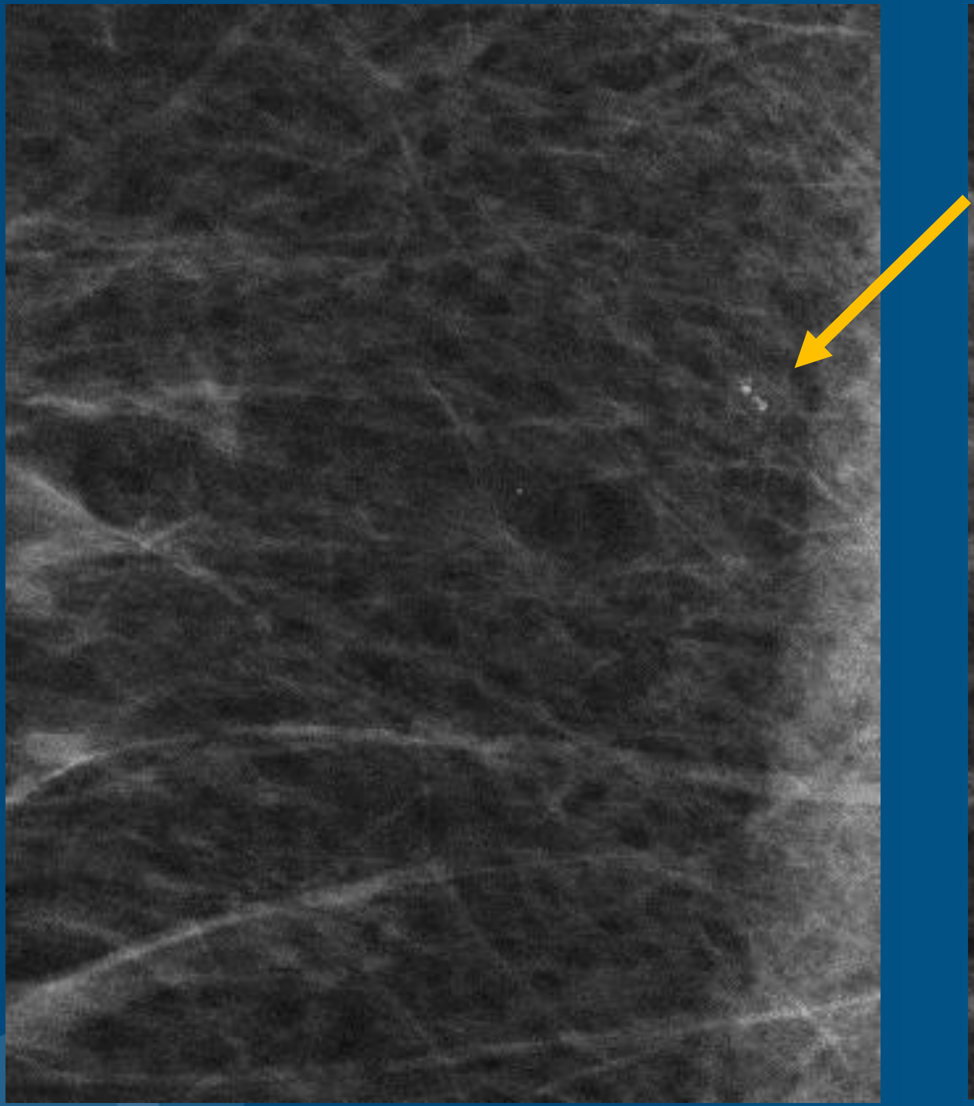
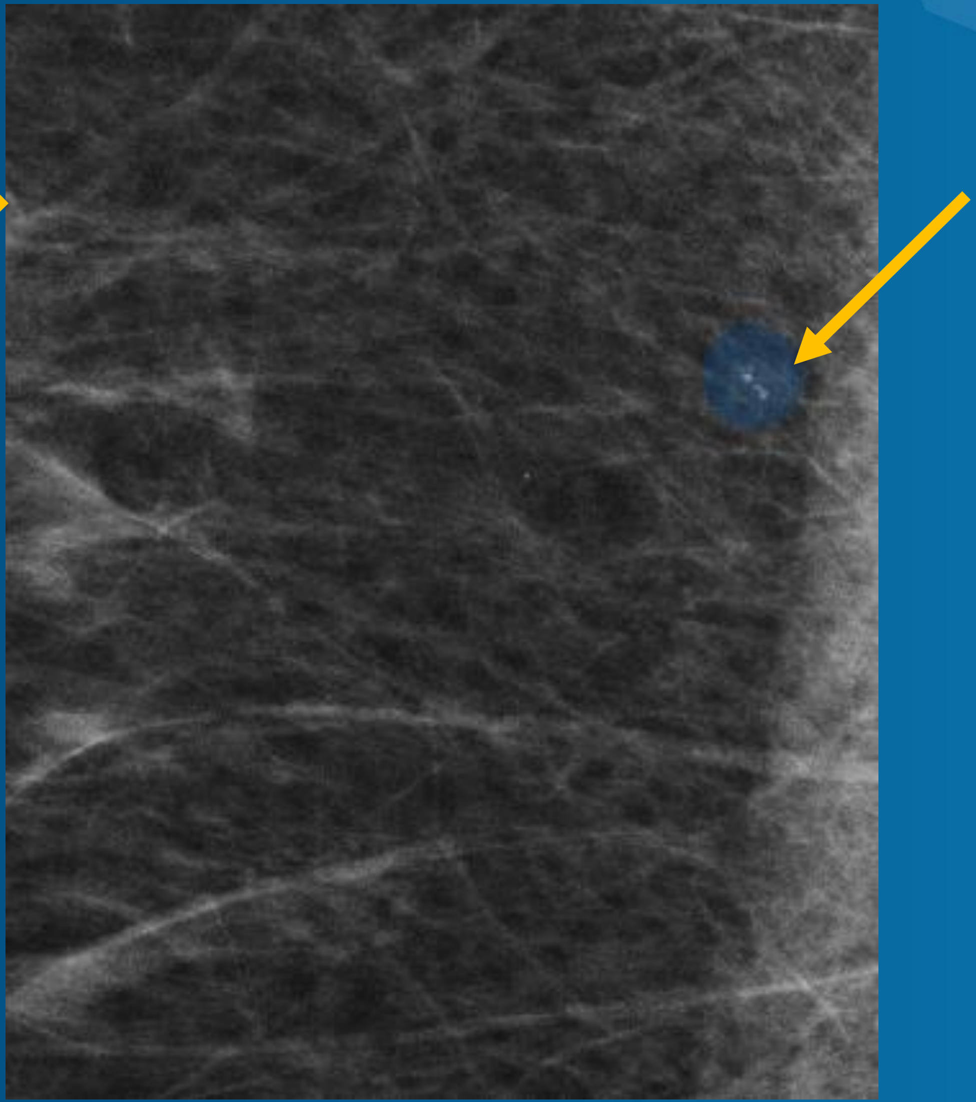


Screening Mammogram without AI



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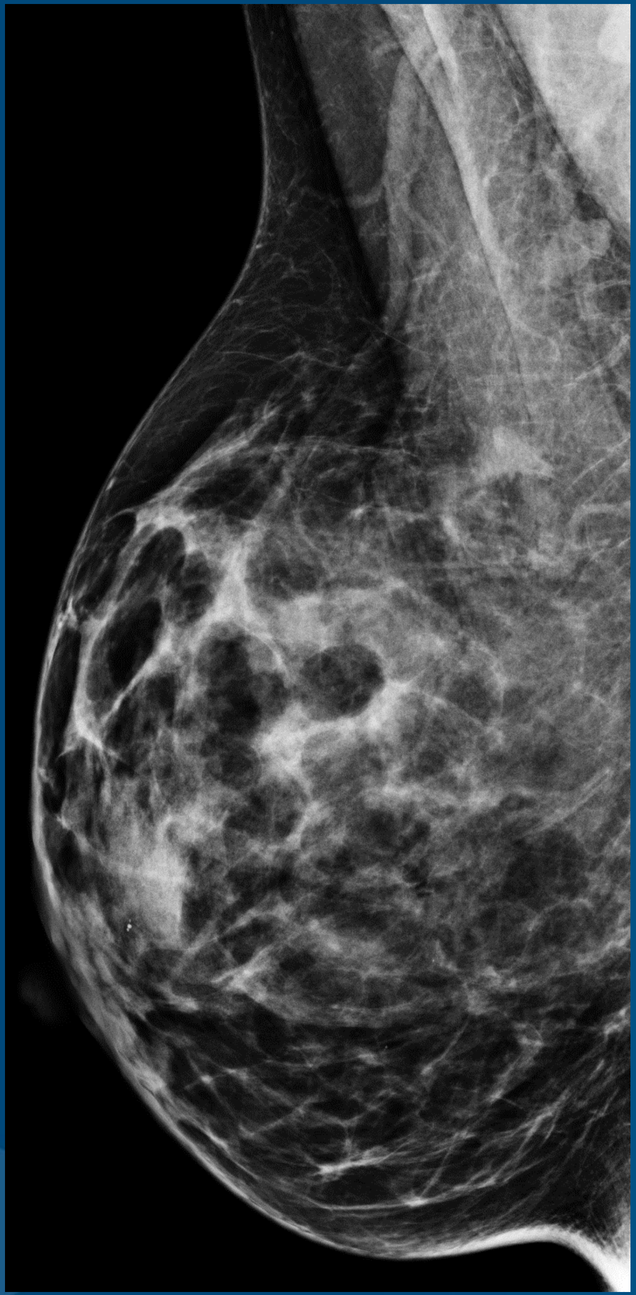
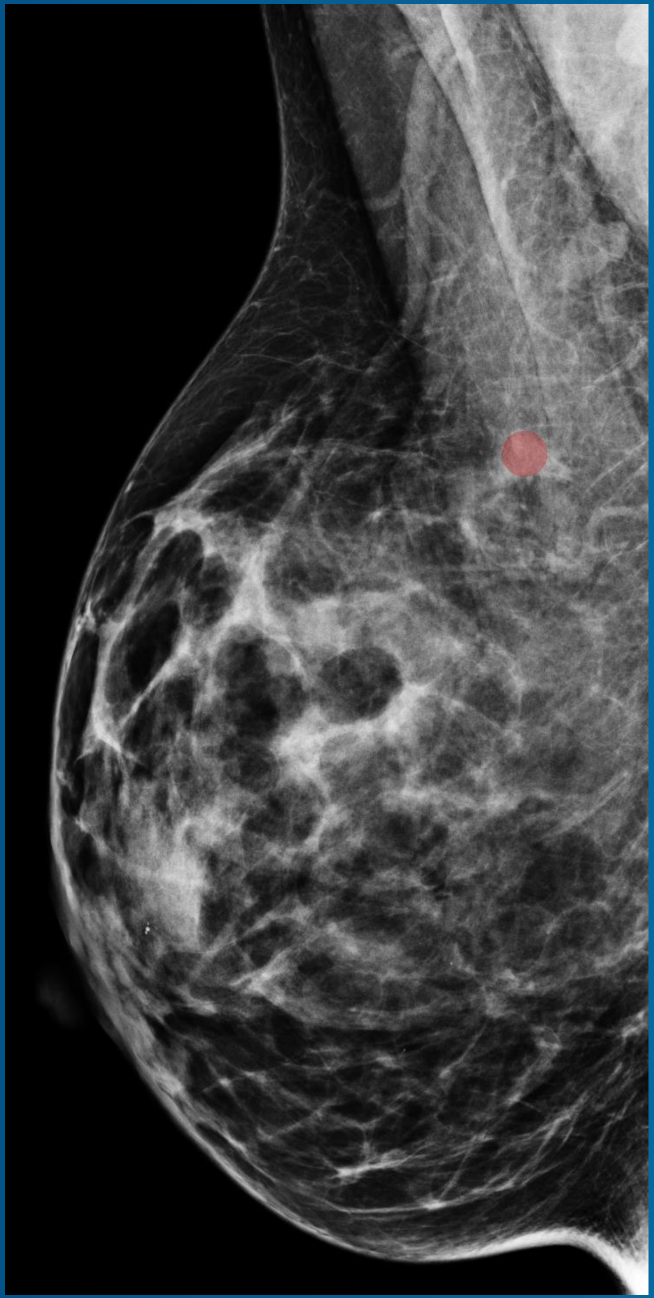

Screening Mammogram without AI


Screening Mammogram with AI (red circle)

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Screening Mammogram without AI

Screening Mammogram with AI (red circle)