Oxford University Hospitals
NHS Foundation Trust

Measuring Density in Breast Screening

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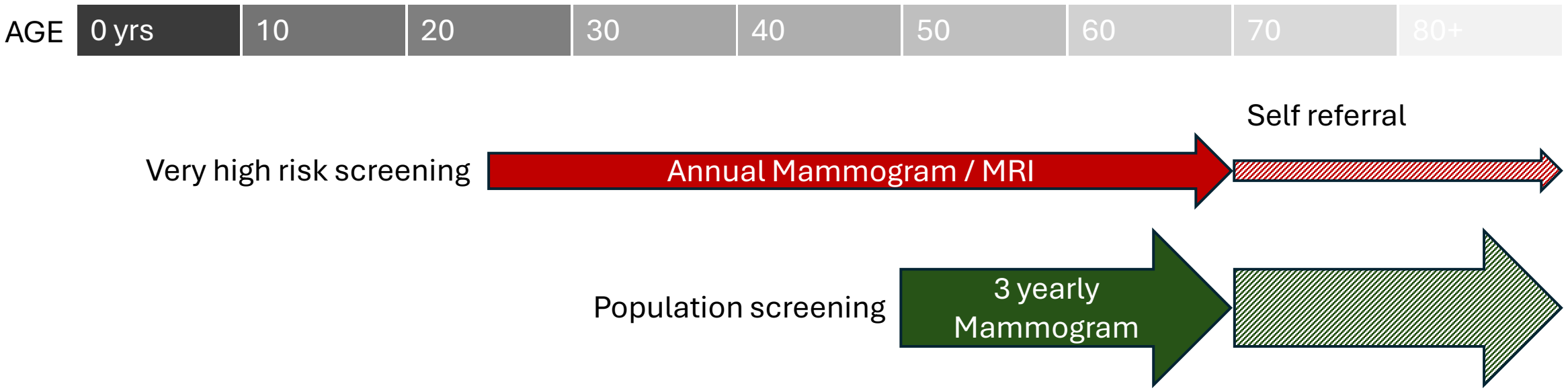
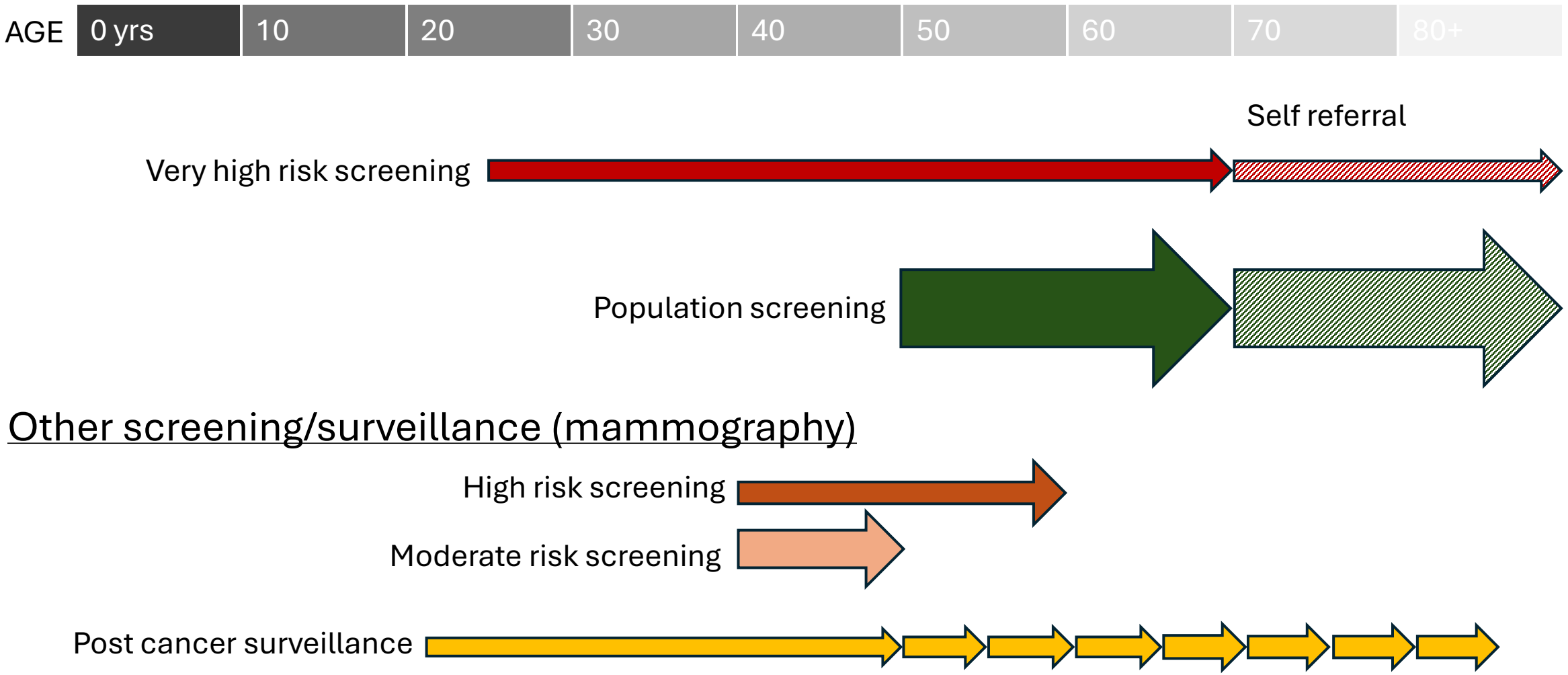
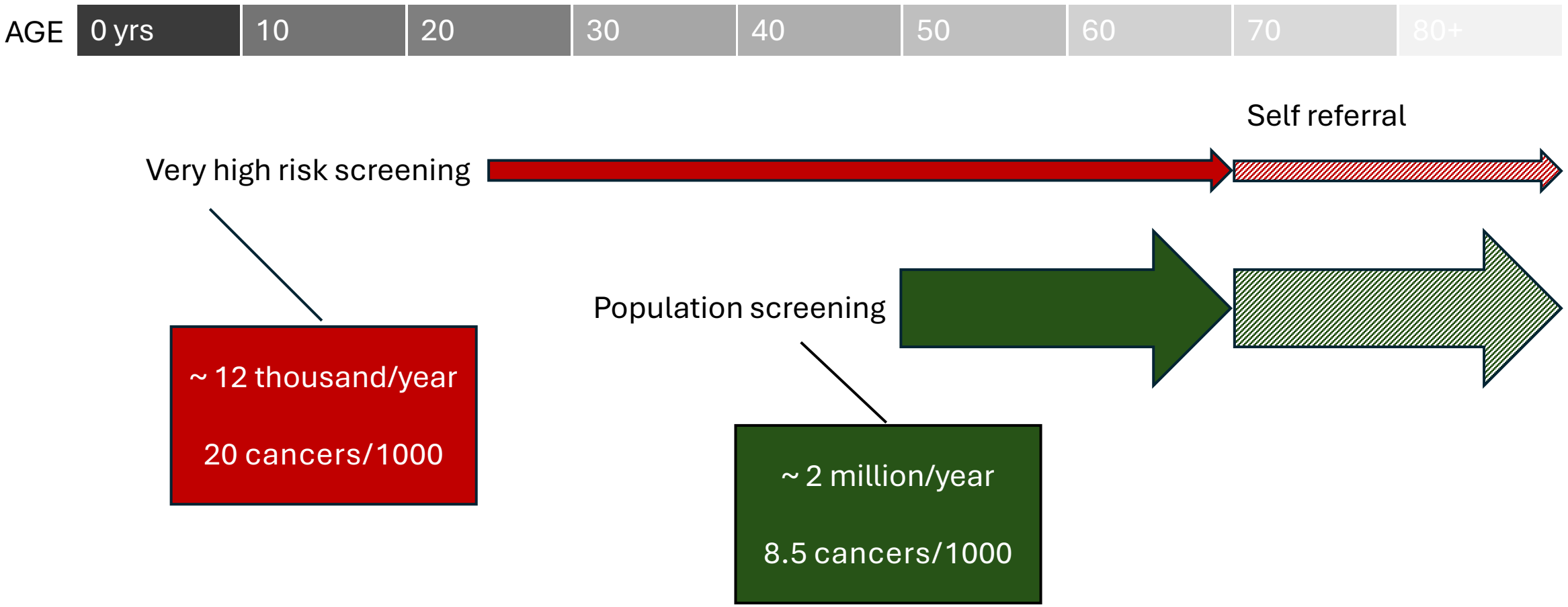
NHS Breast Screening Programme



NHS Breast Screening Programme

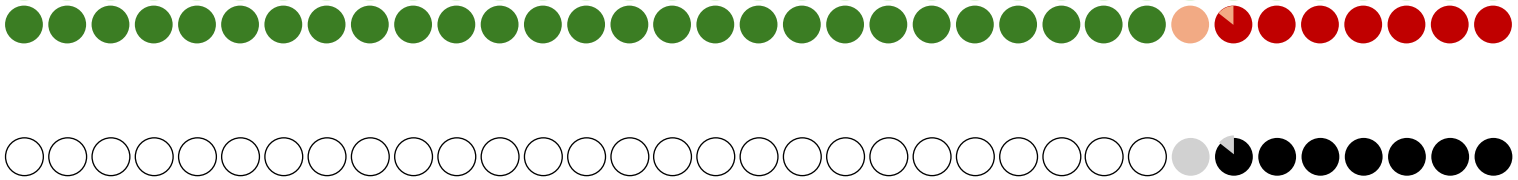


NHS Breast Screening Programme

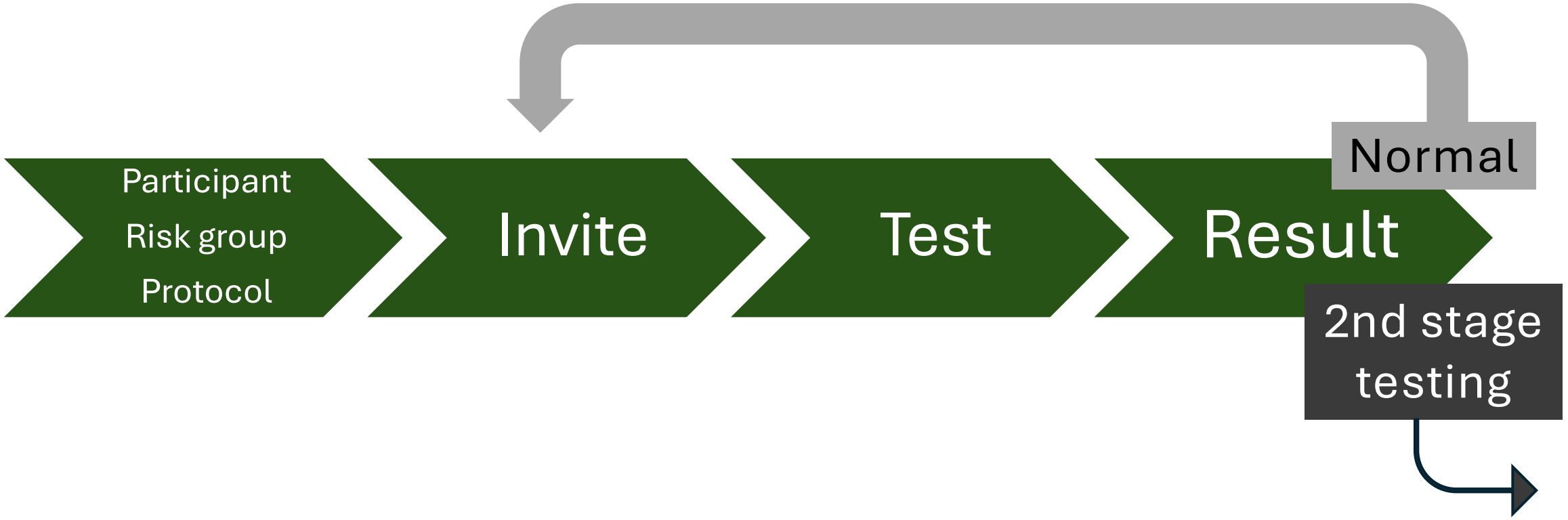


Outcomes of NHS BSP population screening (2023/24 data)

1000 women invited, 35 assessed,
8.5 cancers (including 1.8 non-invasive)

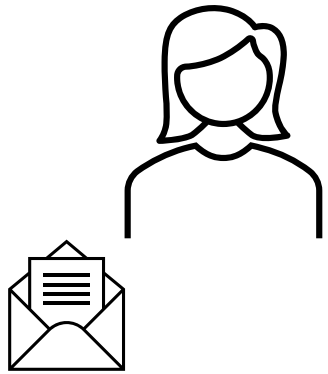


Screening Pathway

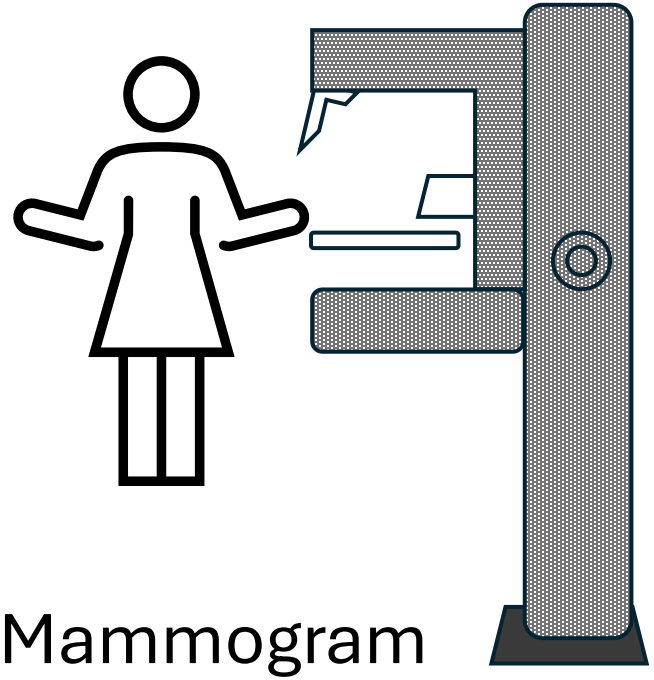


The Screening Test

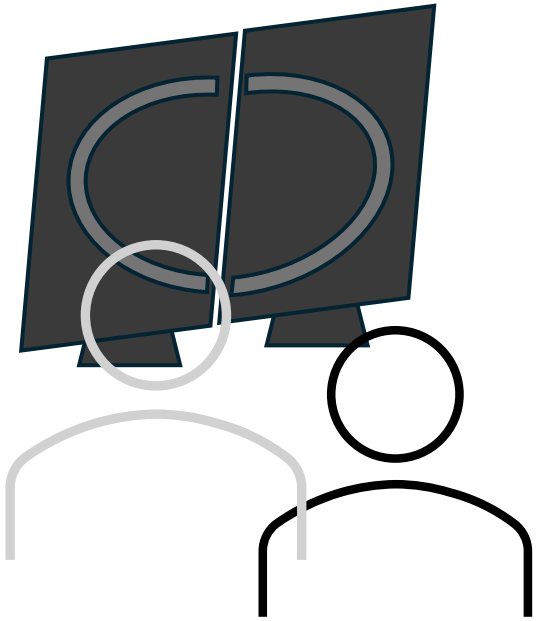
Normal



Invitation



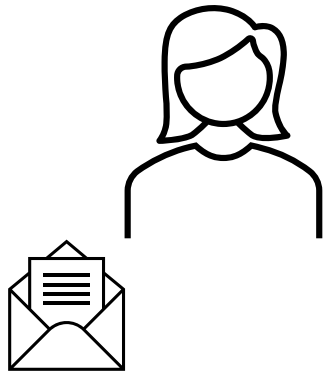
Mammogram



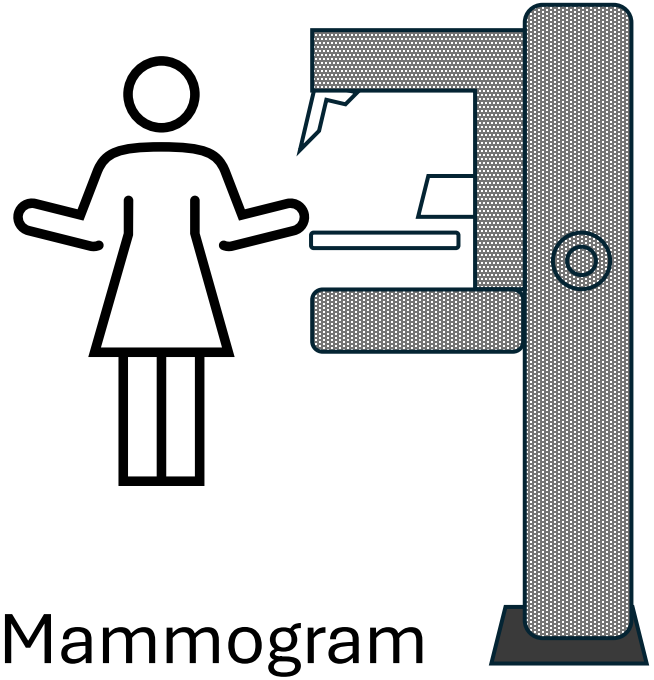
Double reading

2nd stage testing

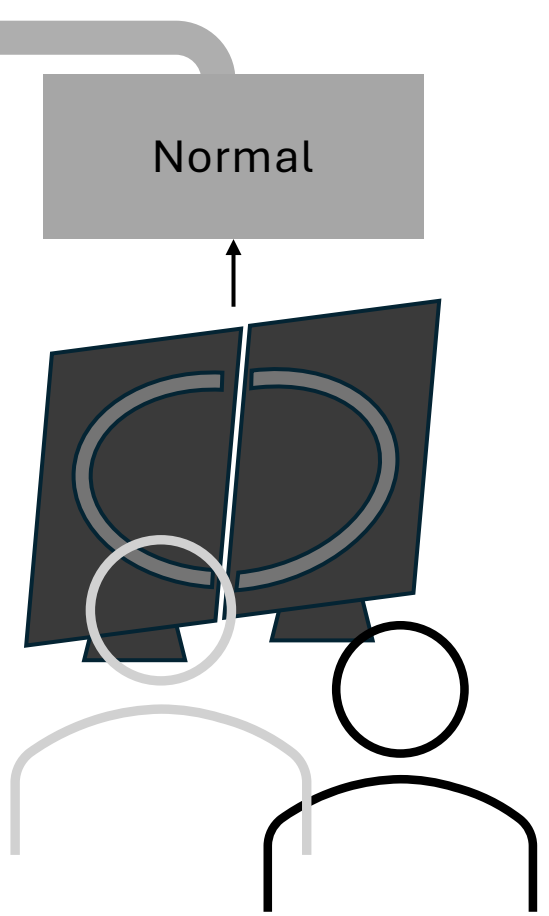
The Screening Test



Invitation



Mammogram

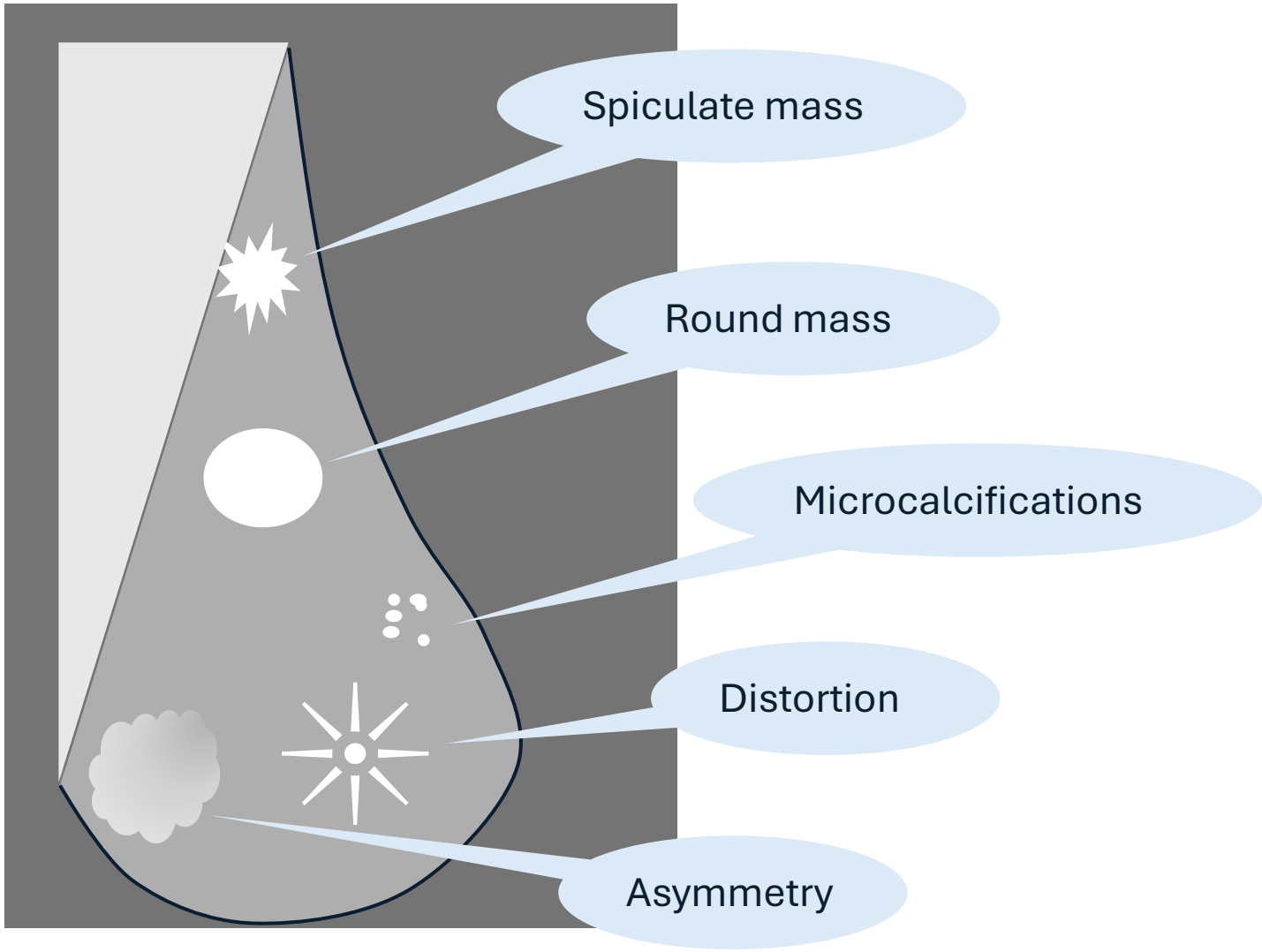


Double reading

2nd stage testing

Mammographic density is not currently recorded at screening in the NHS BSP

What we look for on a mammogram

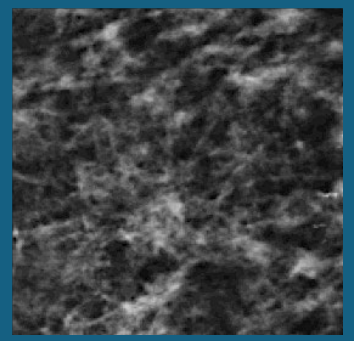


Conspicuity:
– what makes a cancer easy to spot?

Lesion

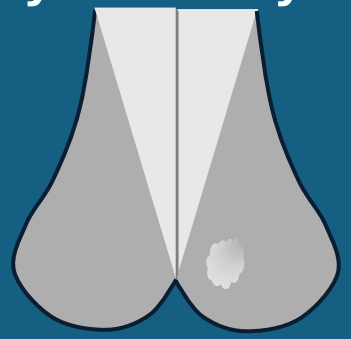
- Size
- Shape
- Edges
- Density

Background



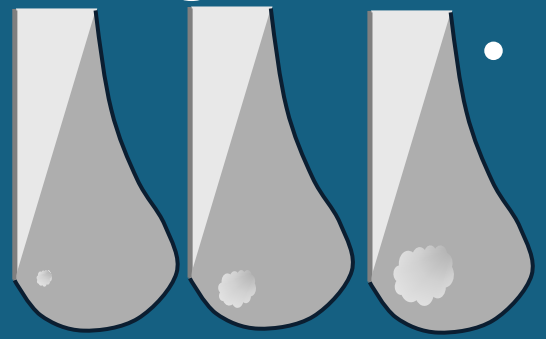
- Density
- Texture/pattern
- Other ‘lesions’

Symmetry



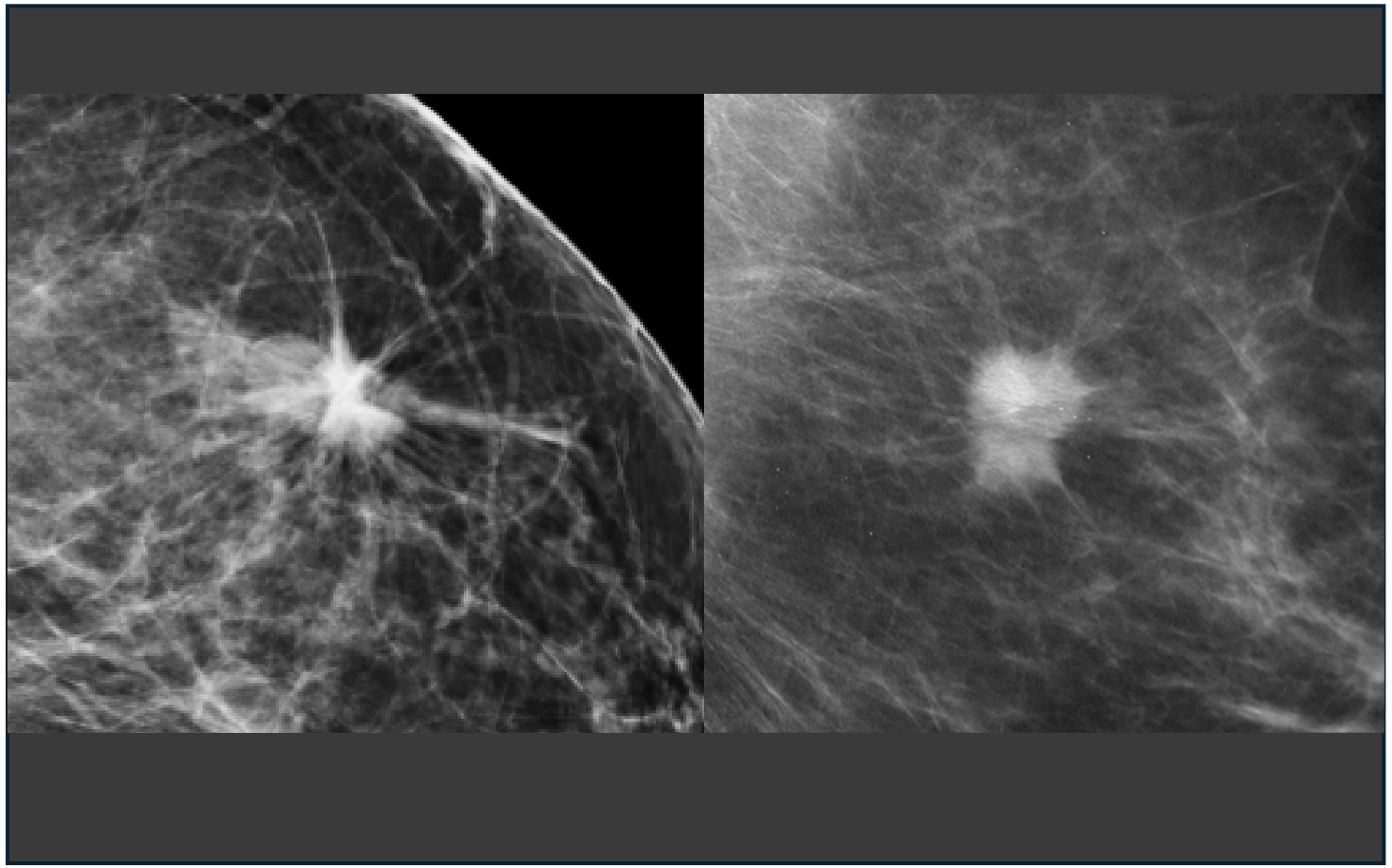
- Difference between right and left breasts

Change



- Focal change

Example - Spiculate mass

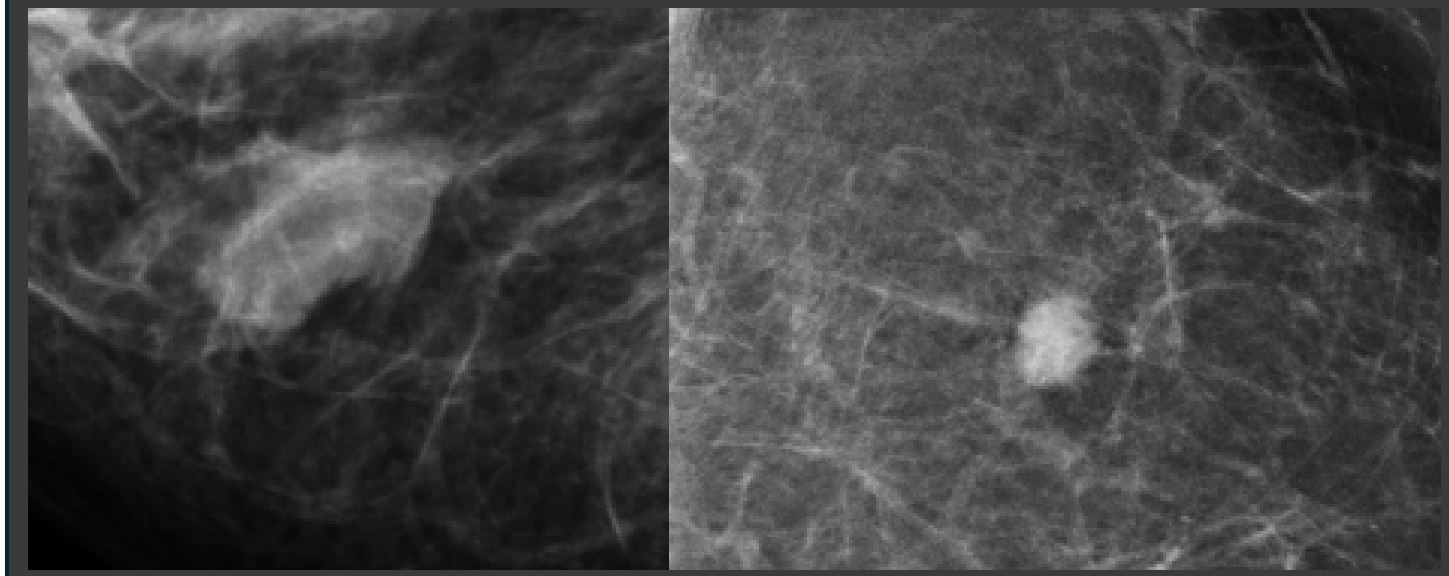


Tend to be

- Malignant (invasive ductal carcinoma)
- Slower growing (lower grade)

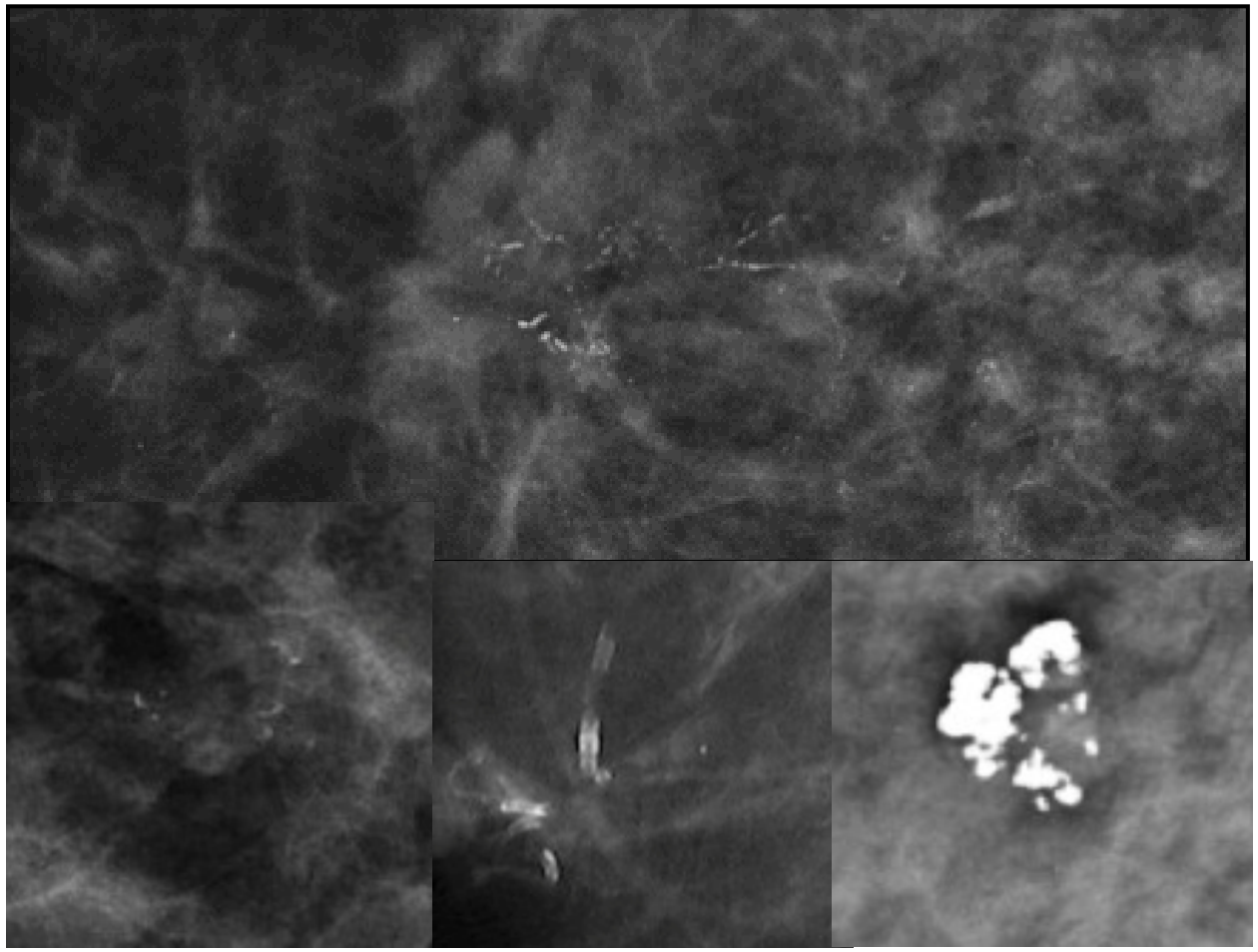
Example - Round mass

- Density of lesion is important



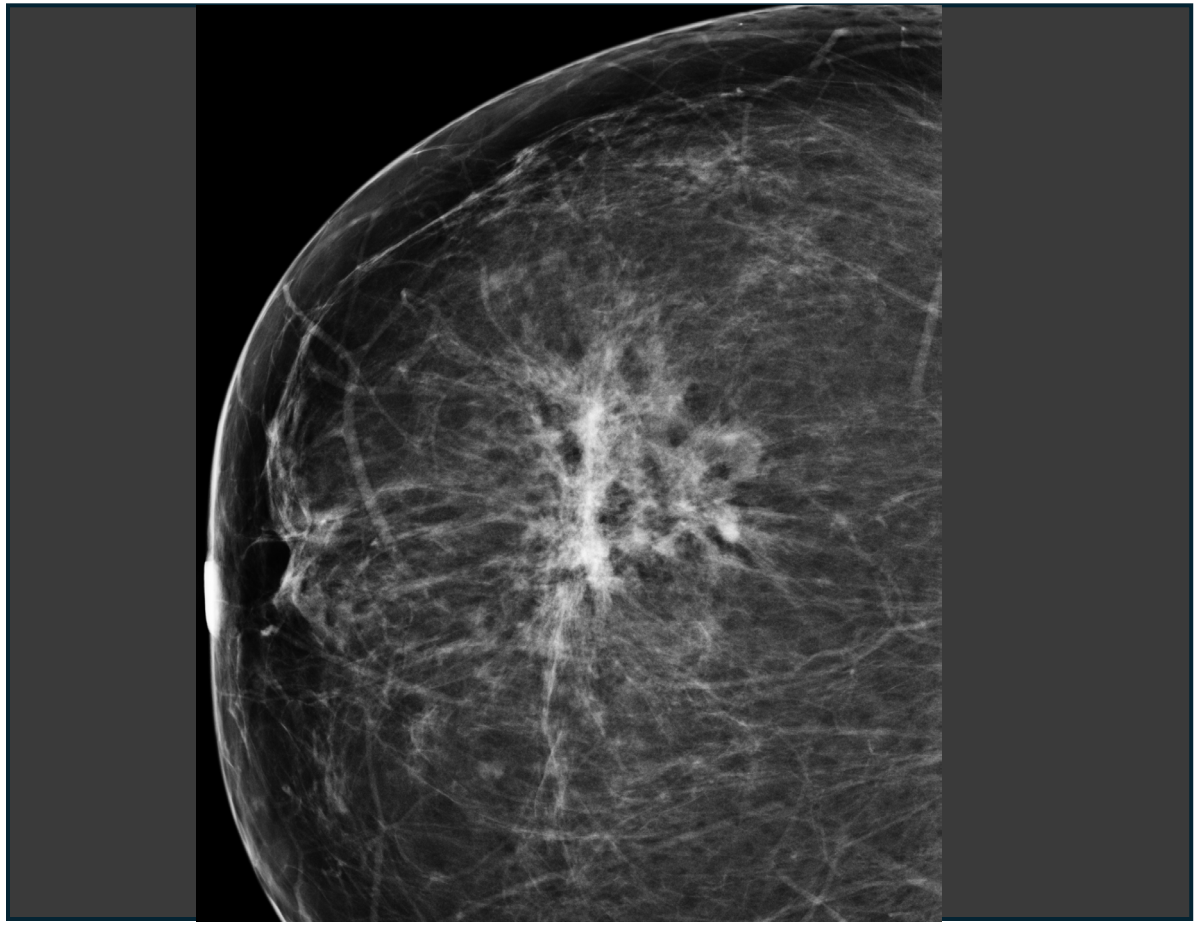
- Usually benign, especially if multiple
- Ultrasound is very useful – solid or cyst
- Density of lesion is important
- Fast growing cancers may mimic benign lesions

Example - Microcalcification



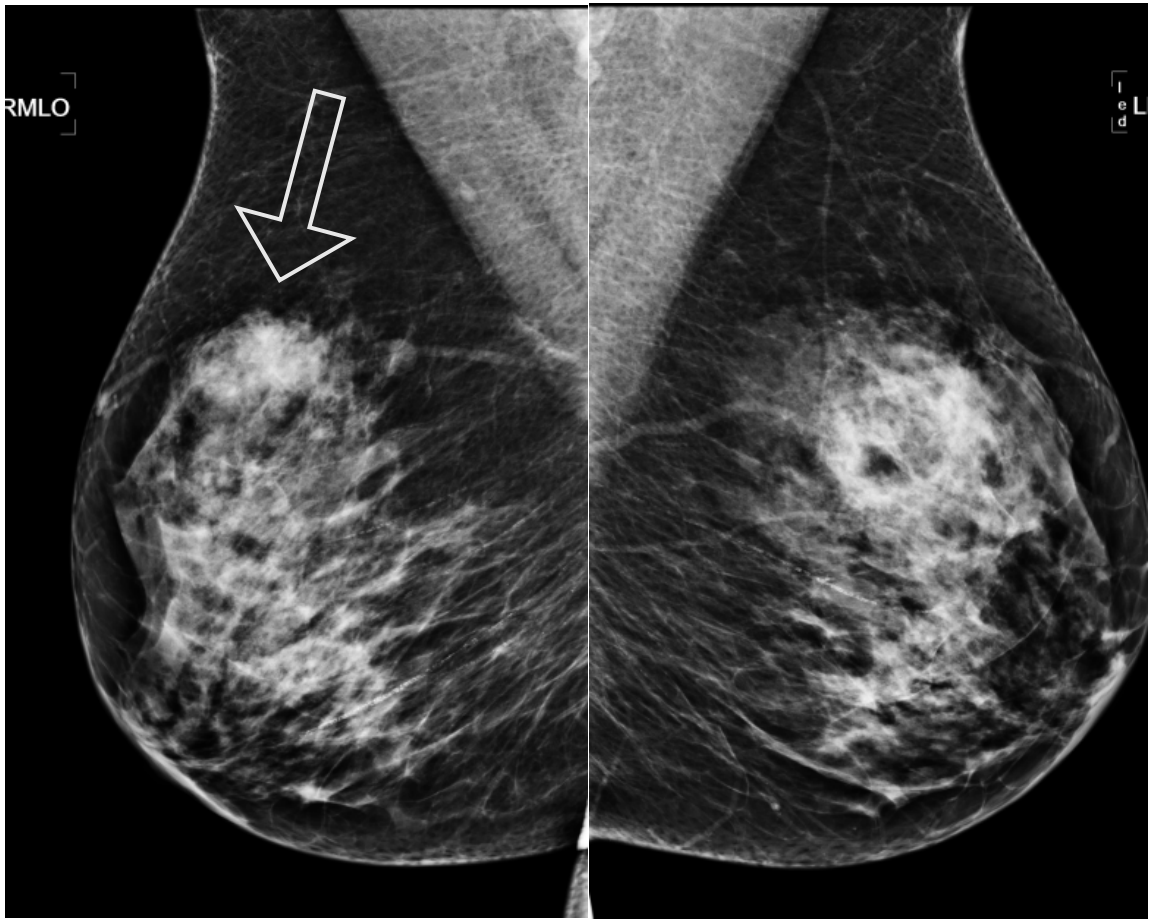
- Typical benign patterns
  - don’t need further tests
- Concern if
  - ‘irregular in shape, size and density’
  - Erratic distribution and orientation
  - Unifocal or regional
- Malignant calcification may be stable for years
- Investigate with biopsy and histopathology

Example - Distortion



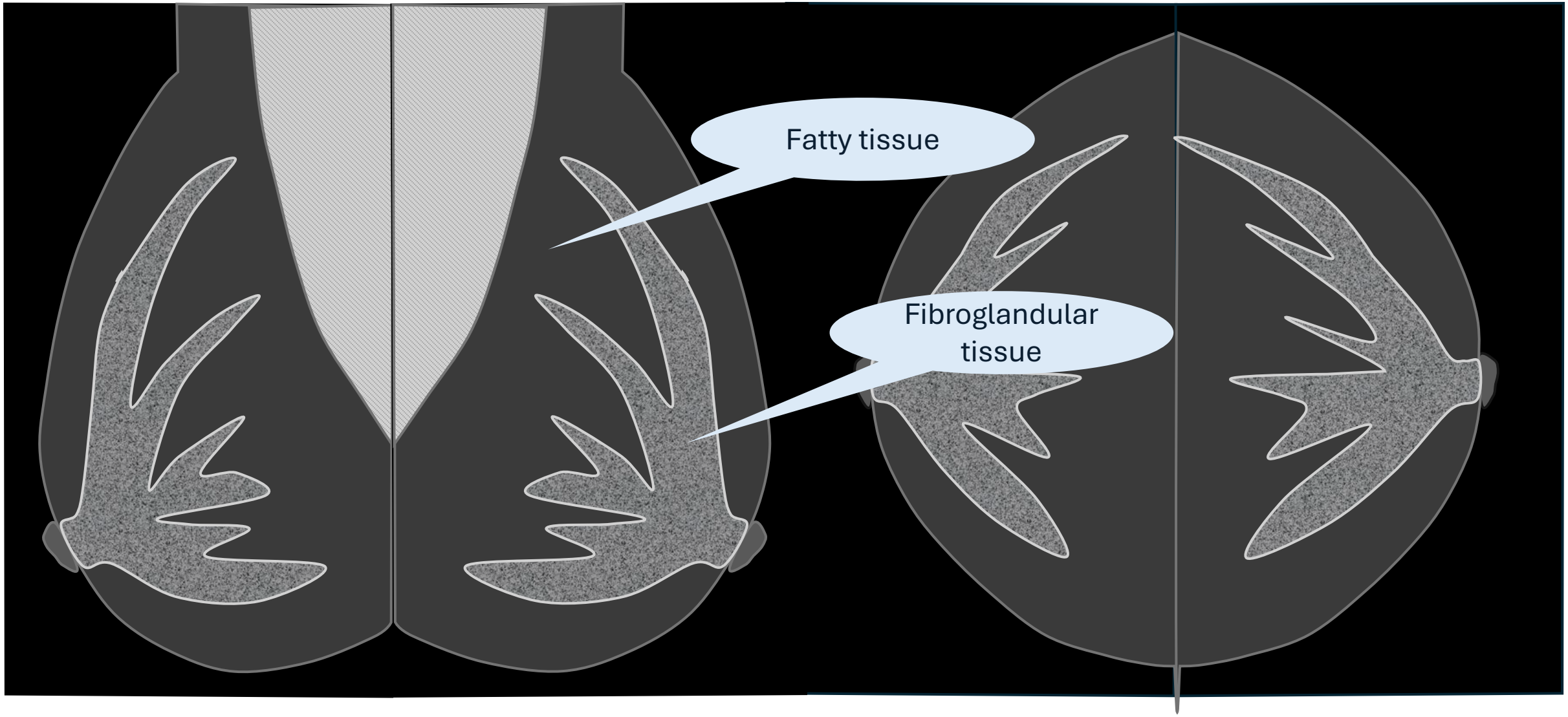
- Underlying cause may be malignant or benign
- Tends to be slower growing

Example - Asymmetry

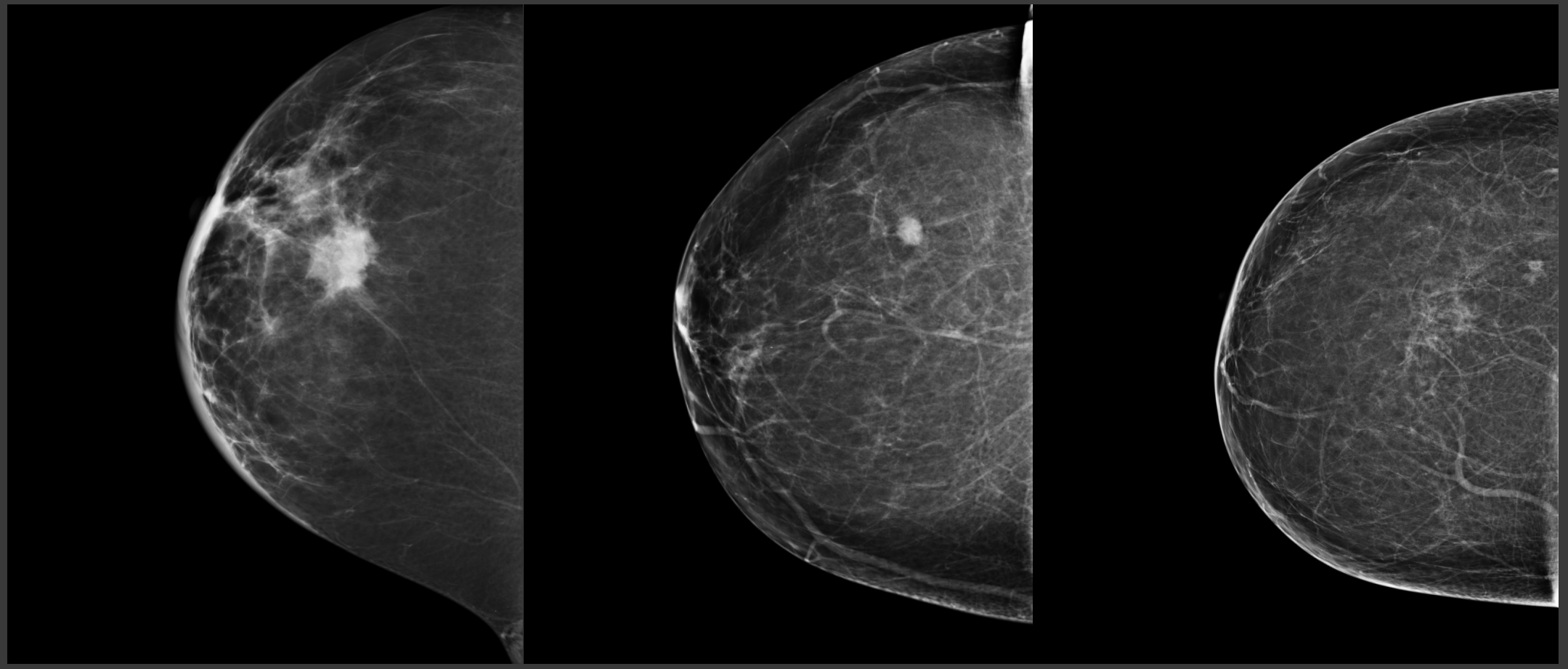


- Likely to be benign if stable and ultrasound normal
- Palpable mass – more concerning
- Look for interval change and associated signs – calcifications, distortion, mass,

What do we mean by breast density?

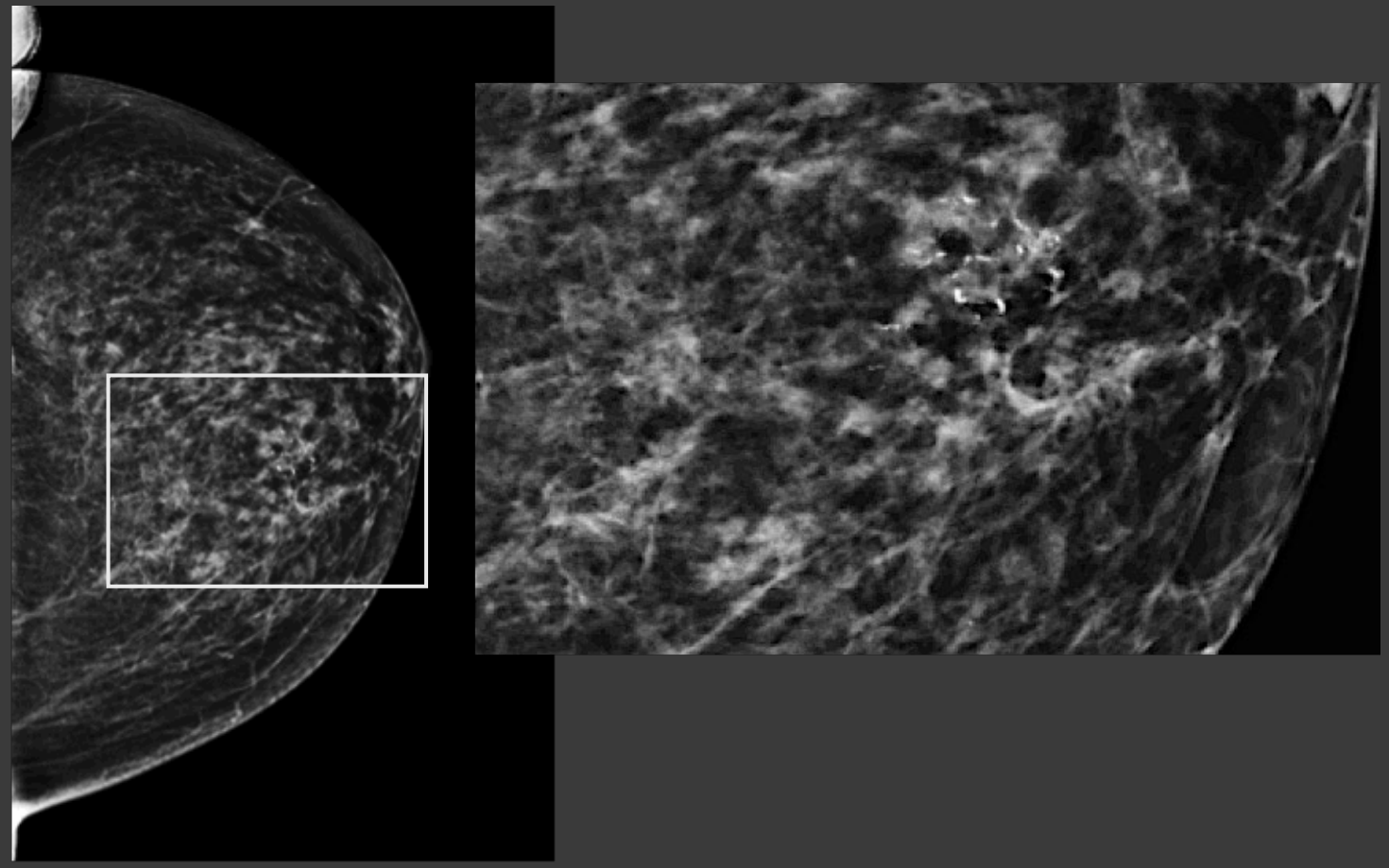


Examples – low density breast



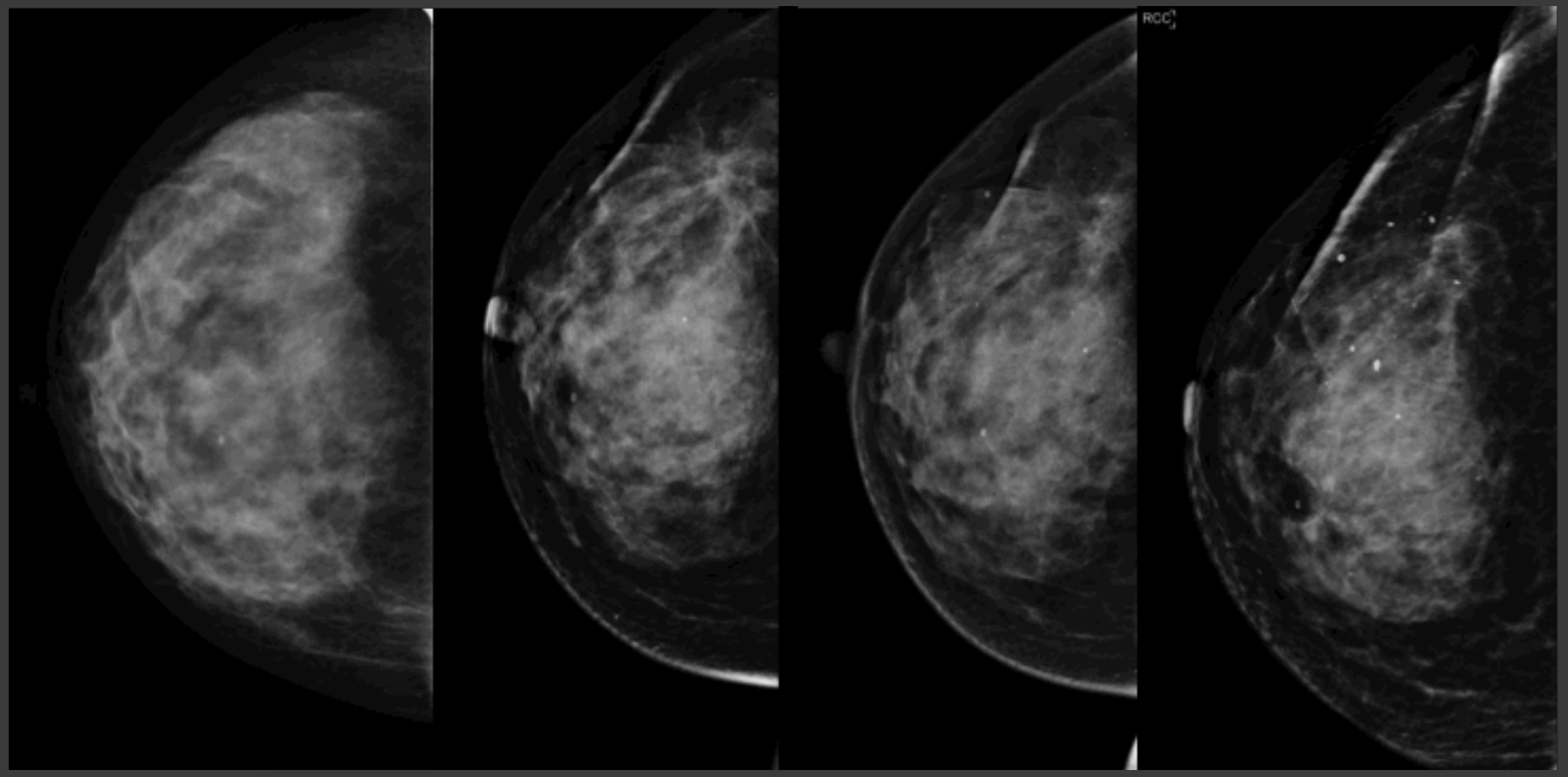
Examples – mixed density breast

24mm cancer



55 mm cancer

Example - high density breast



2006

2008

2009

2012

2006: 28mm cancer

2012: extensive cancer on biopsy

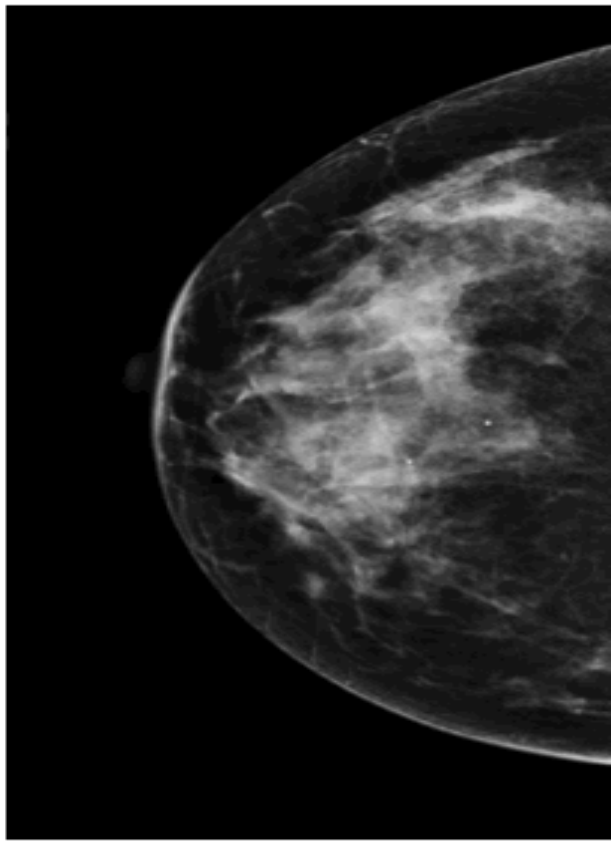
Why does breast density matter?

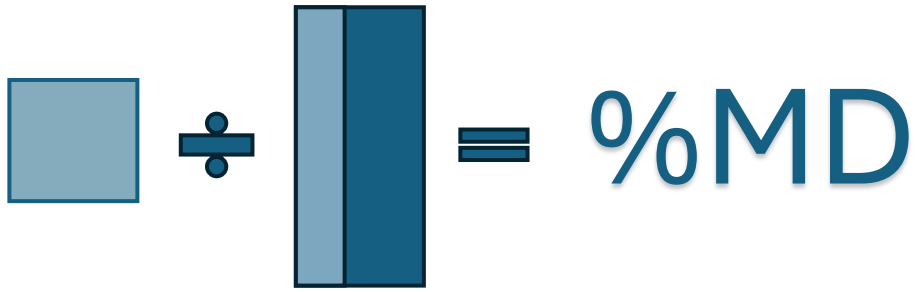
- Breast cancer risk: Women with dense breasts have a higher chance of getting breast cancer. The more dense your breasts are, the higher your risk. Scientists don't know for sure why this is true. Breast cancer patients who have dense breasts are not more likely to die from breast cancer than patients with non-dense (fatty) breasts.

- Mammograms: Dense tissue can hide cancers. Fibrous and glandular tissue looks white on a mammogram. So does a possible tumor. Because it's hard to tell the difference between a tumor and dense breast tissue on a mammogram, a ~~small~~ tumor may be missed.

https://www.cdc.gov/breast-cancer/about/dense-breasts.html

How do we measure breast density?

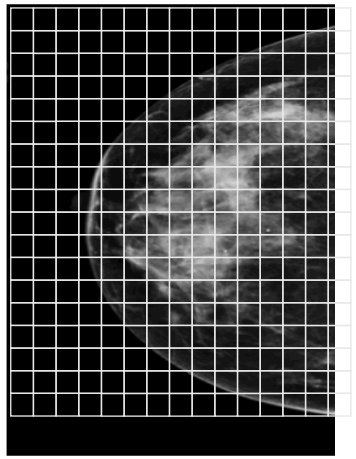




Percentage mammographic density

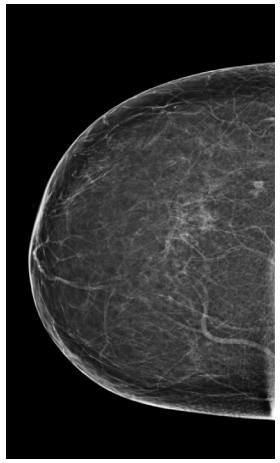
Methods for assessing breast density

Area based



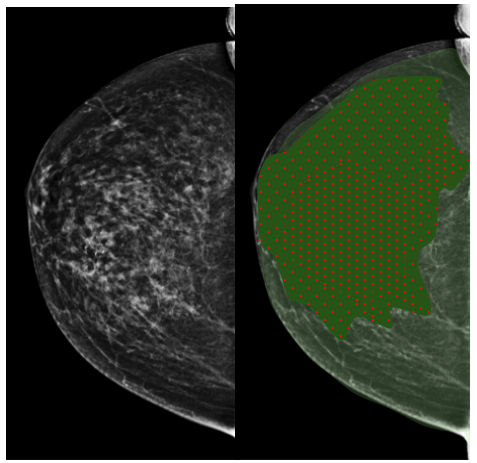
<u>Patterns and Planimetry</u>

Wolfe 1976
Tabar 1997



<u>Visual Estimation</u>

Boyd 1995

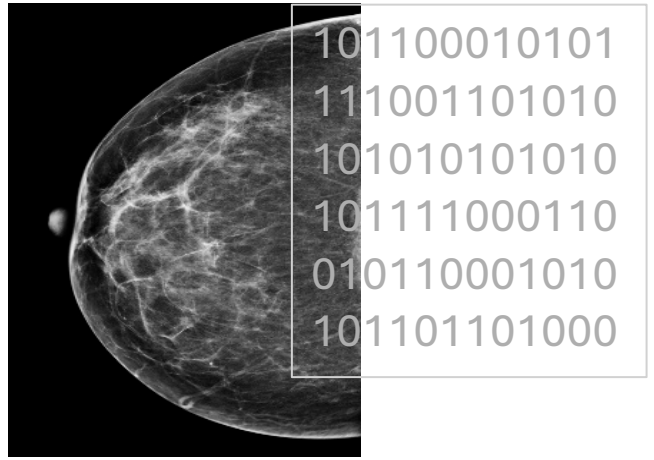


<u>Semi automated</u>

Yaffe 1994

Manual or computed
Visual assessment varies with observer
Variable number of categories
Various descriptions of density and pattern

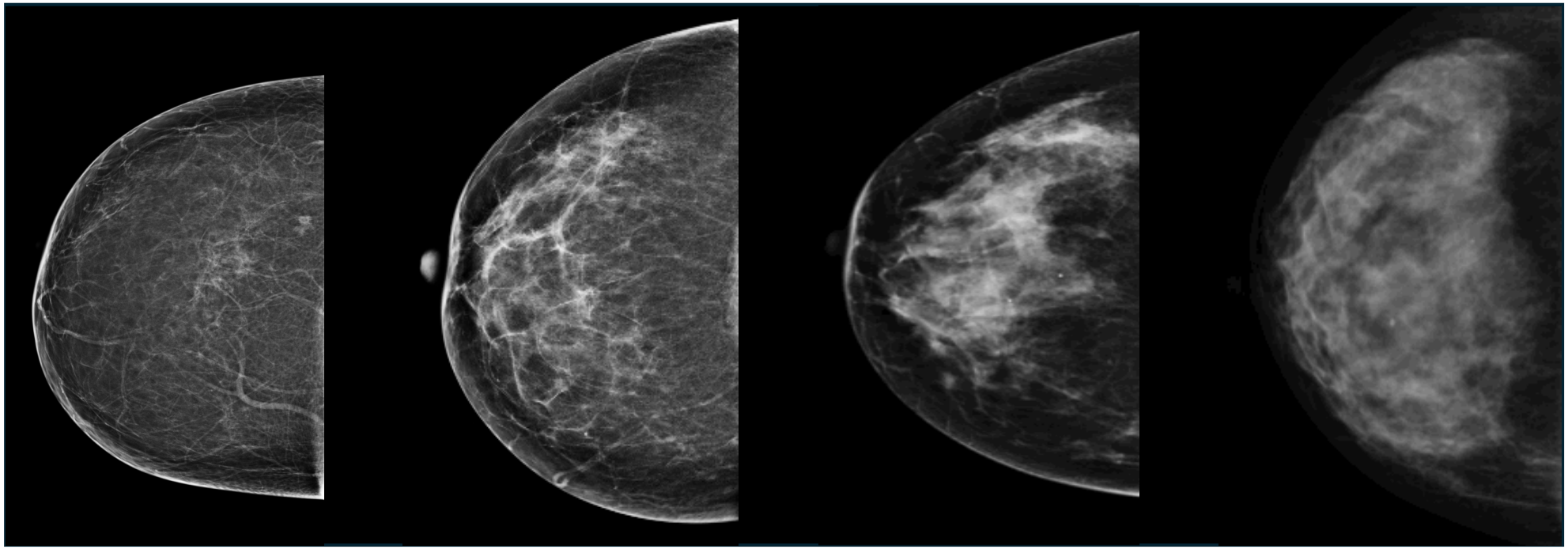
3D Volumetric



<u>Automated</u>
Volpara™, Densitas™, Quantra™ etc

- Fibroglandular volume (FGV)
- Breast volume (TBV)
- Percentage mammographic density (%MD)

BI-RADS



a = The breasts are almost entirely fatty

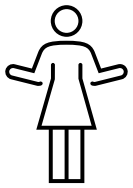
b = There are scattered areas of fibroglandular density

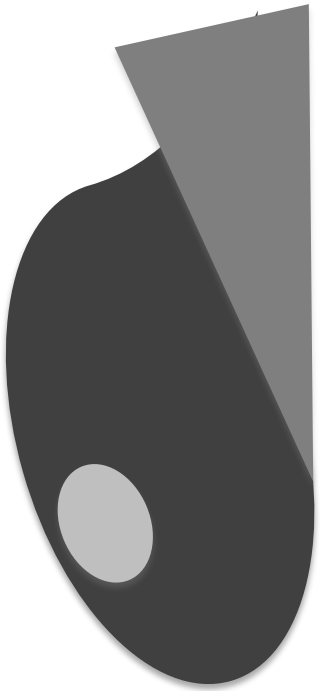
c = The breasts are heterogeneously dense, which may obscure small masses

d = The breasts are extremely dense, which lowers the sensitivity of mammography

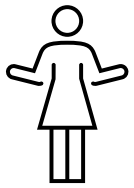
https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Reporting-and-Data-Systems/BI-RADS

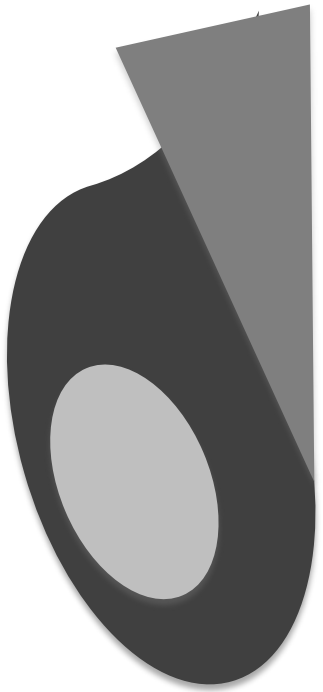
Absolute risk and ‘masking’





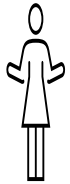
5%



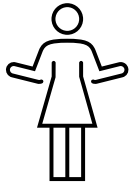


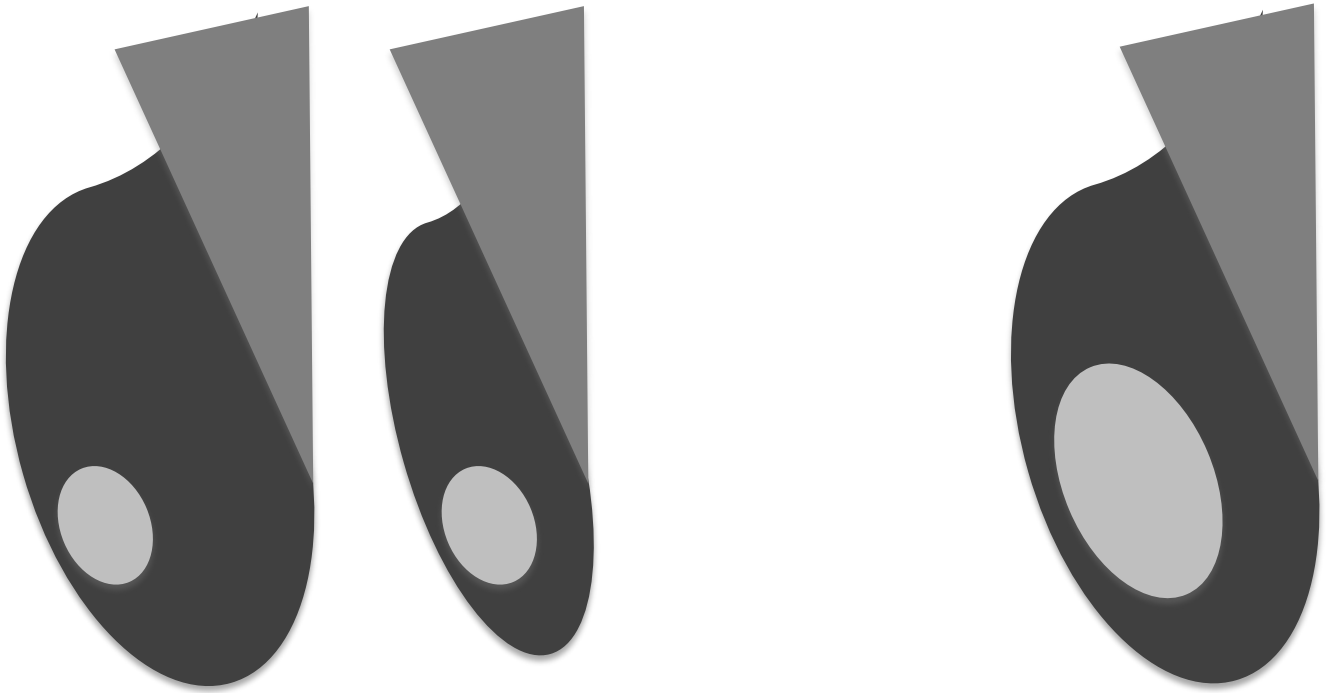
40%

Absolute risk and ‘masking’



BMI reduces

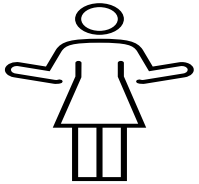




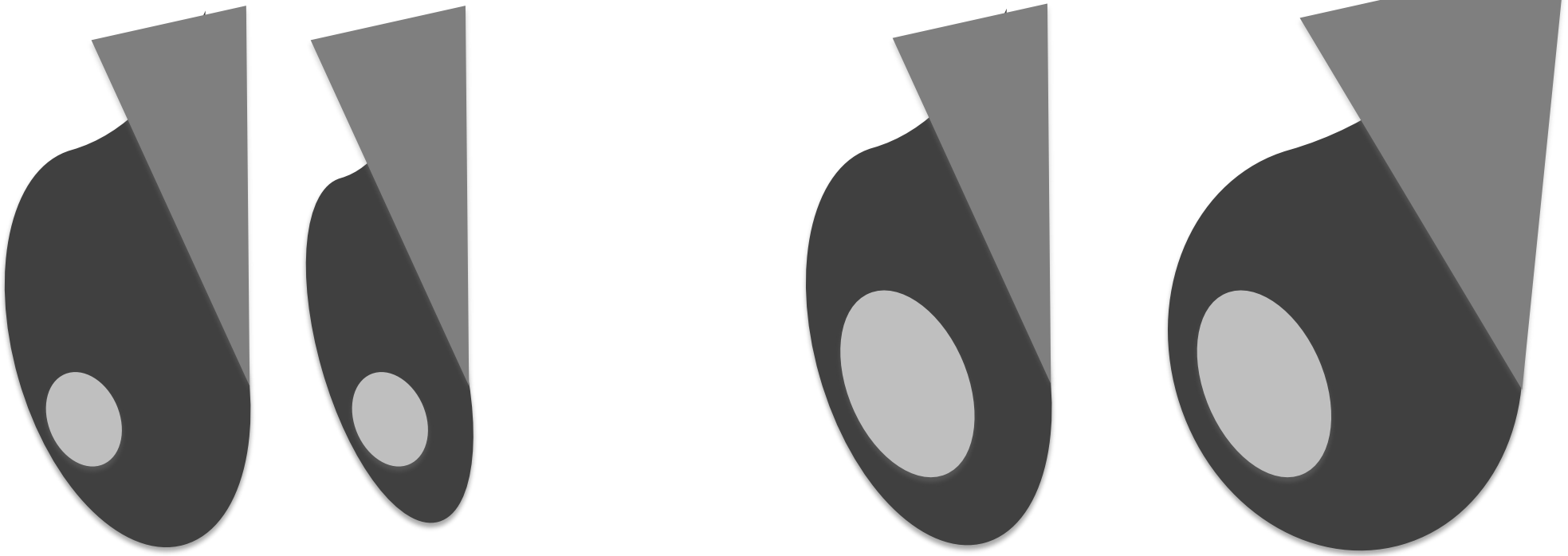
5% 20% 40%

Absolute risk and ‘masking’

BMI reduces

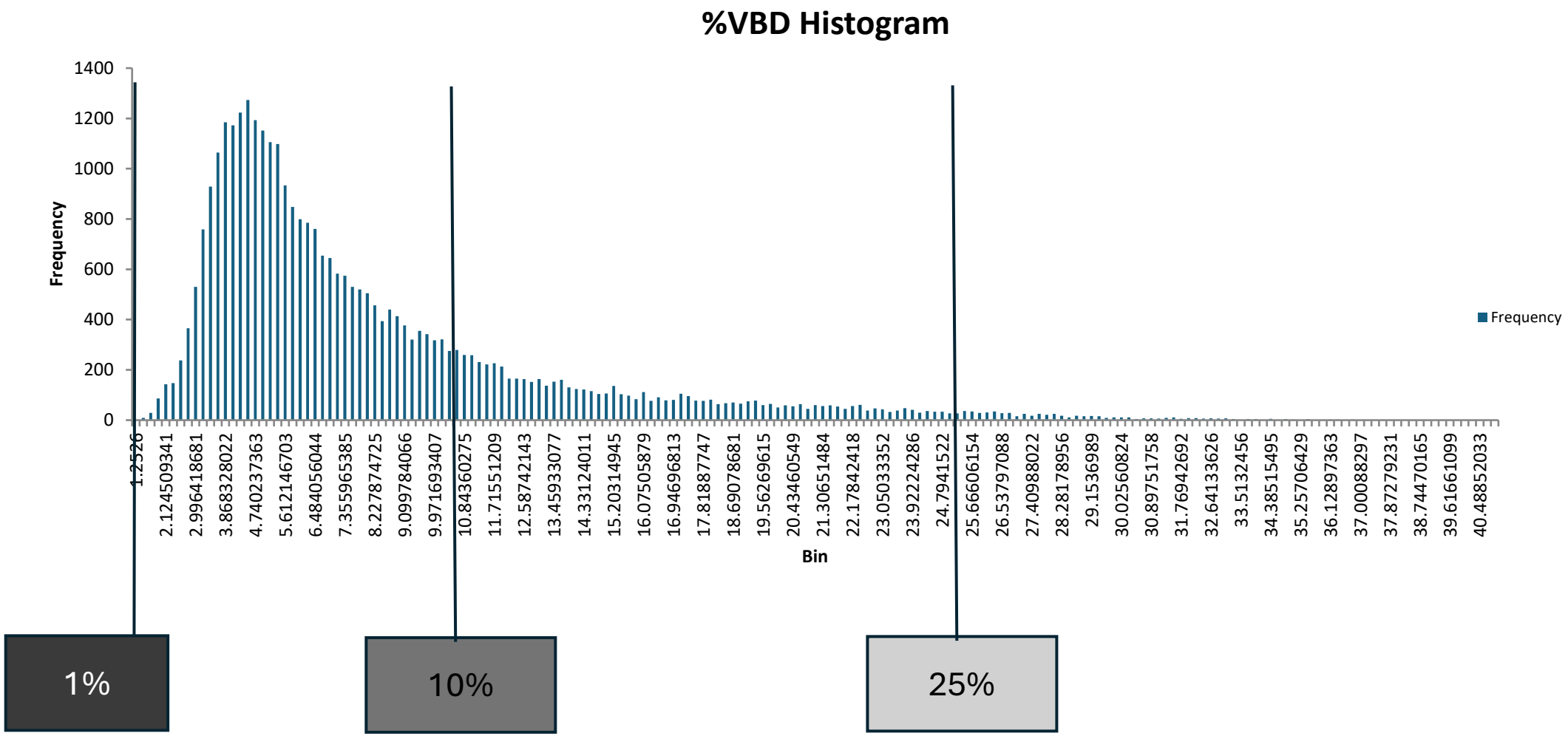


BMI increases



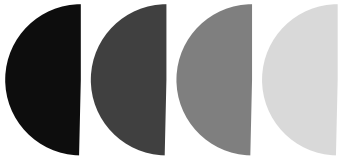
5% 20% 40% 20%

Range of % Volumetric Mammographic Density



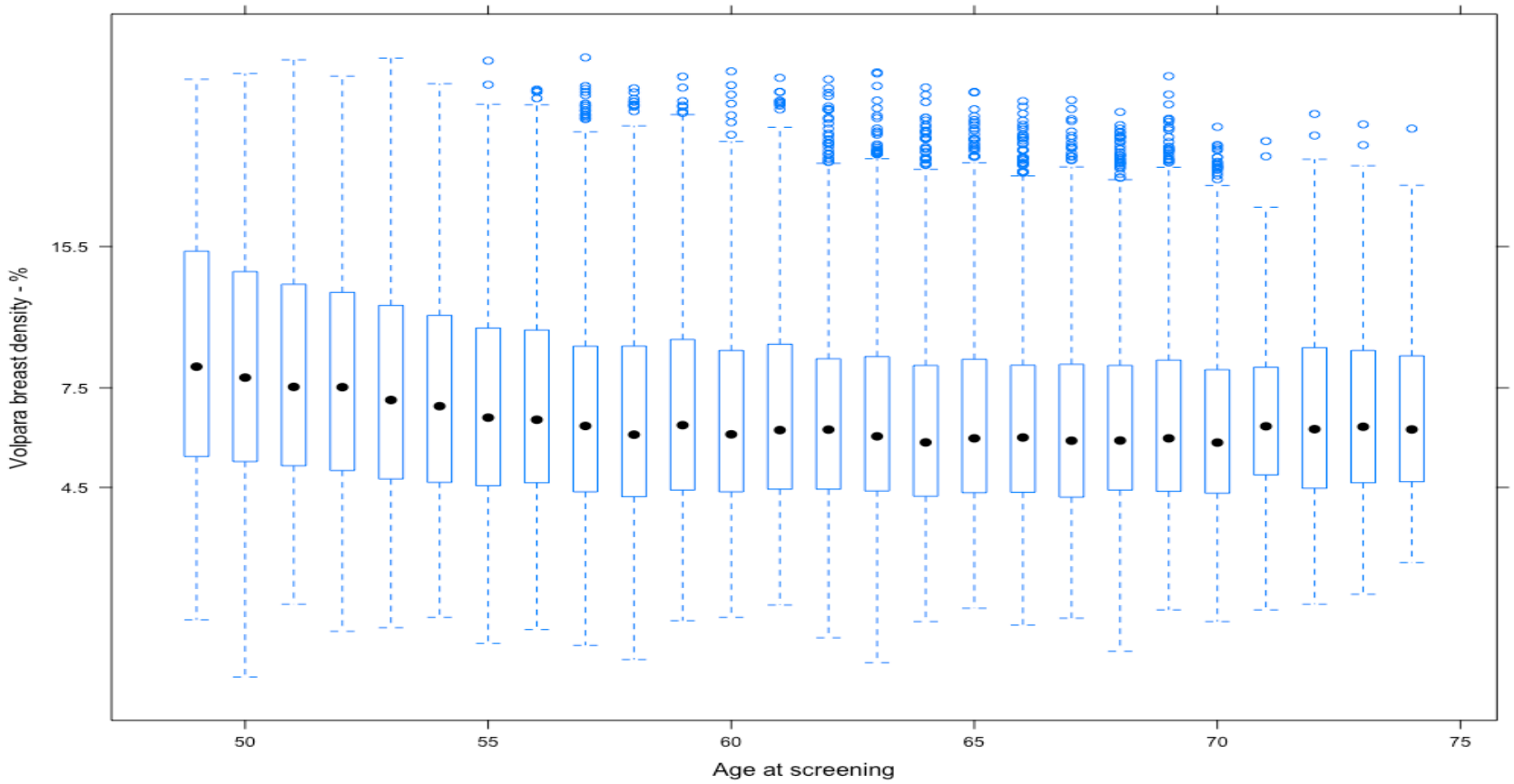
Heller, BJR, 2015, 33k screening mammograms

Why does breast density matter?

	Increased Risk of Developing Cancer	Increased Recall for Further Tests	Increased Risk of Interval Cancer
			
Fibroglandular Volume	Q1.....:.....Q4 = 1 : 3.7		Q1.....:.....Q4. = 1 : 5.3
Density Grade (BI-RADS)	1.....4 = 1 : 2.6	1.....4 = 1:1.51	1.....4 = 1 : 4.7
% density (volume)	Q1.....Q4 = 1 : 1.6		Q1.....Q4 = 1: 2.7

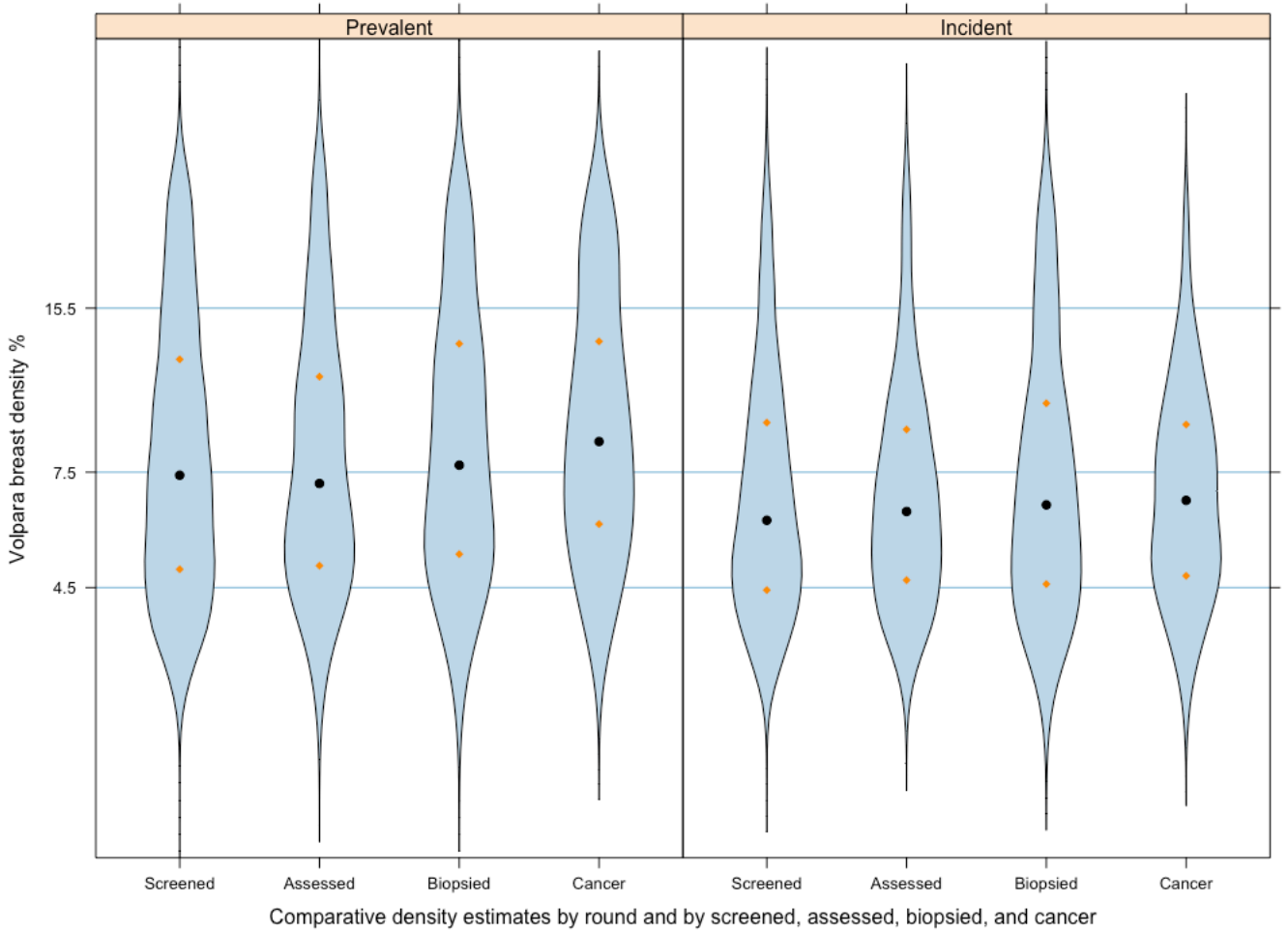
Burnside, BJC 2021;
Payne, European Radiology 2025

Variation in breast density with age



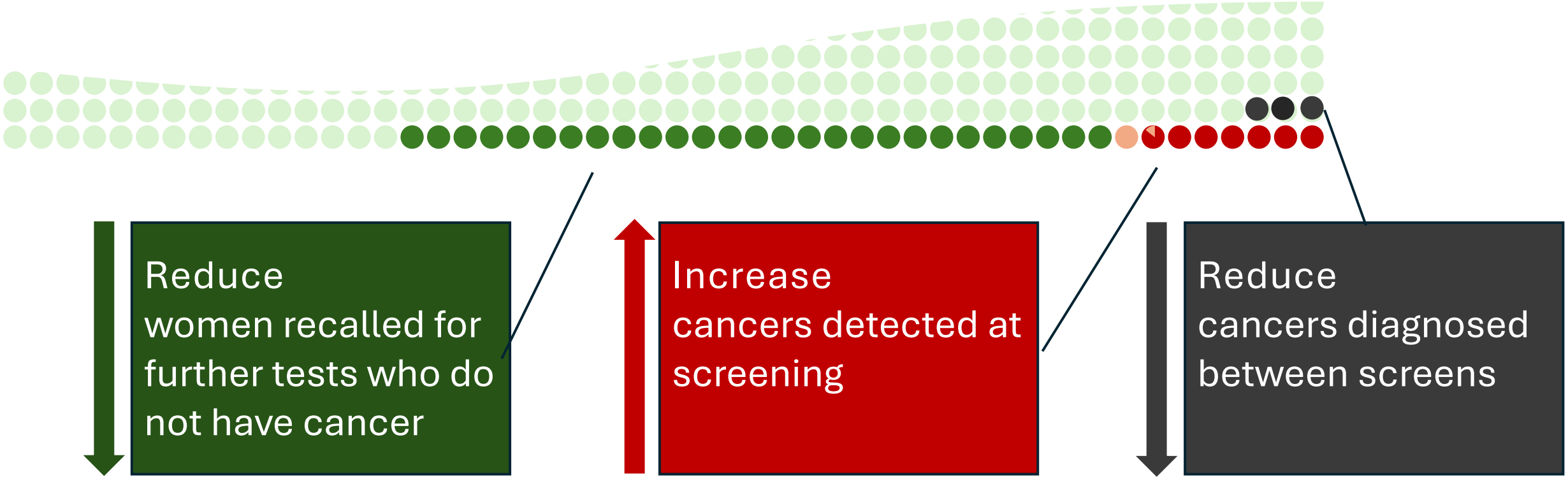
Heller, BJR, 2015,

Outcome of screening by round (age) and density



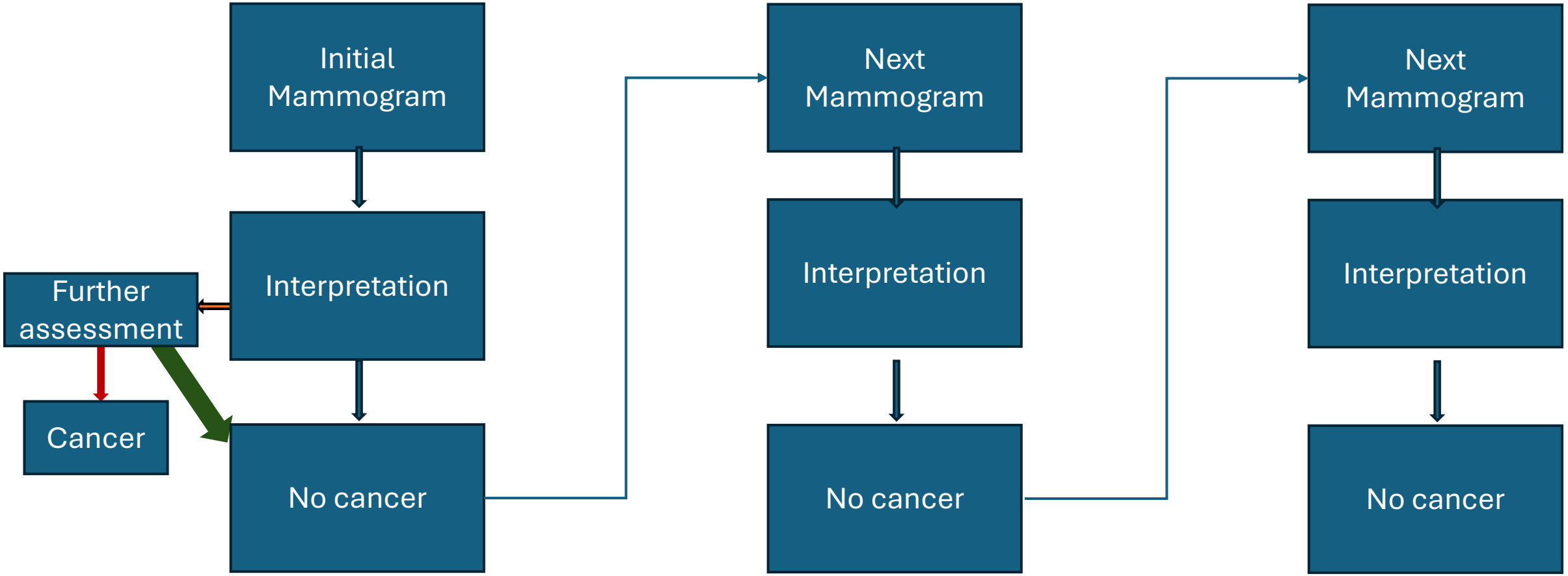
Heller, BJR, 2015,

Change in screening protocol should aim to:

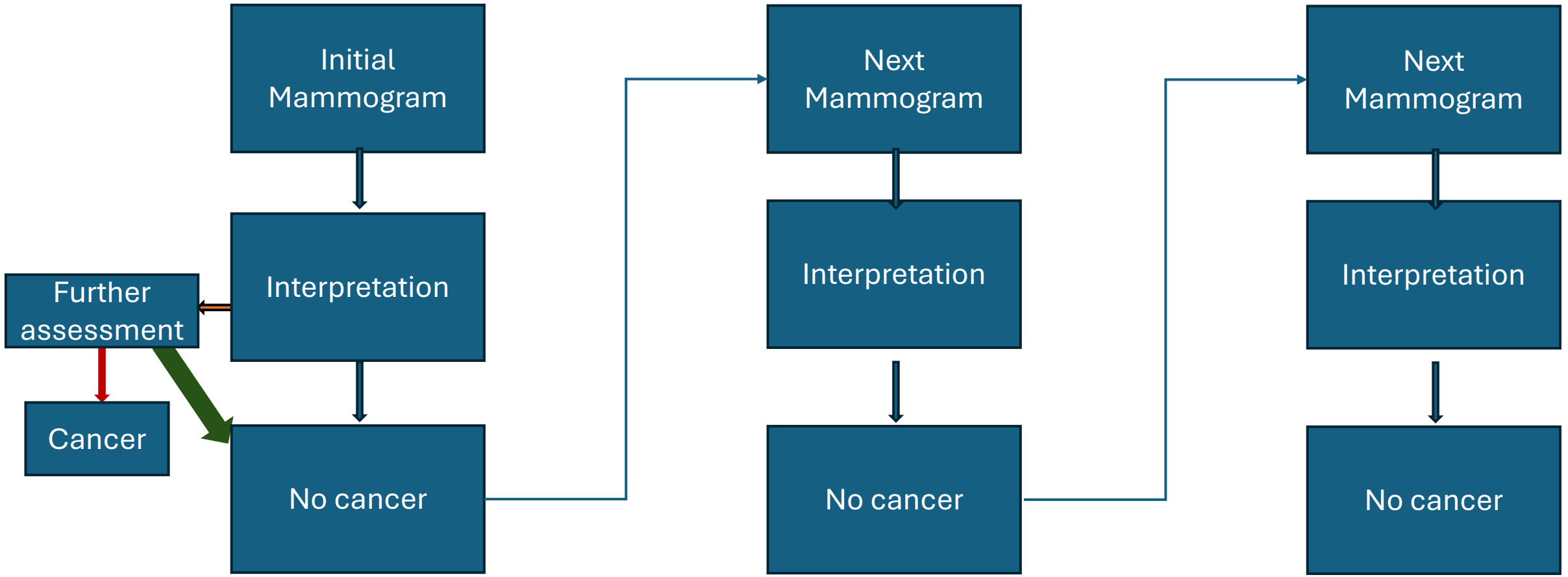


Cancers are not all the same:
Minimise overdiagnosis and overtreatment

Examples of Pathway with risk adapted screening



Examples of Pathway with risk adapted screening

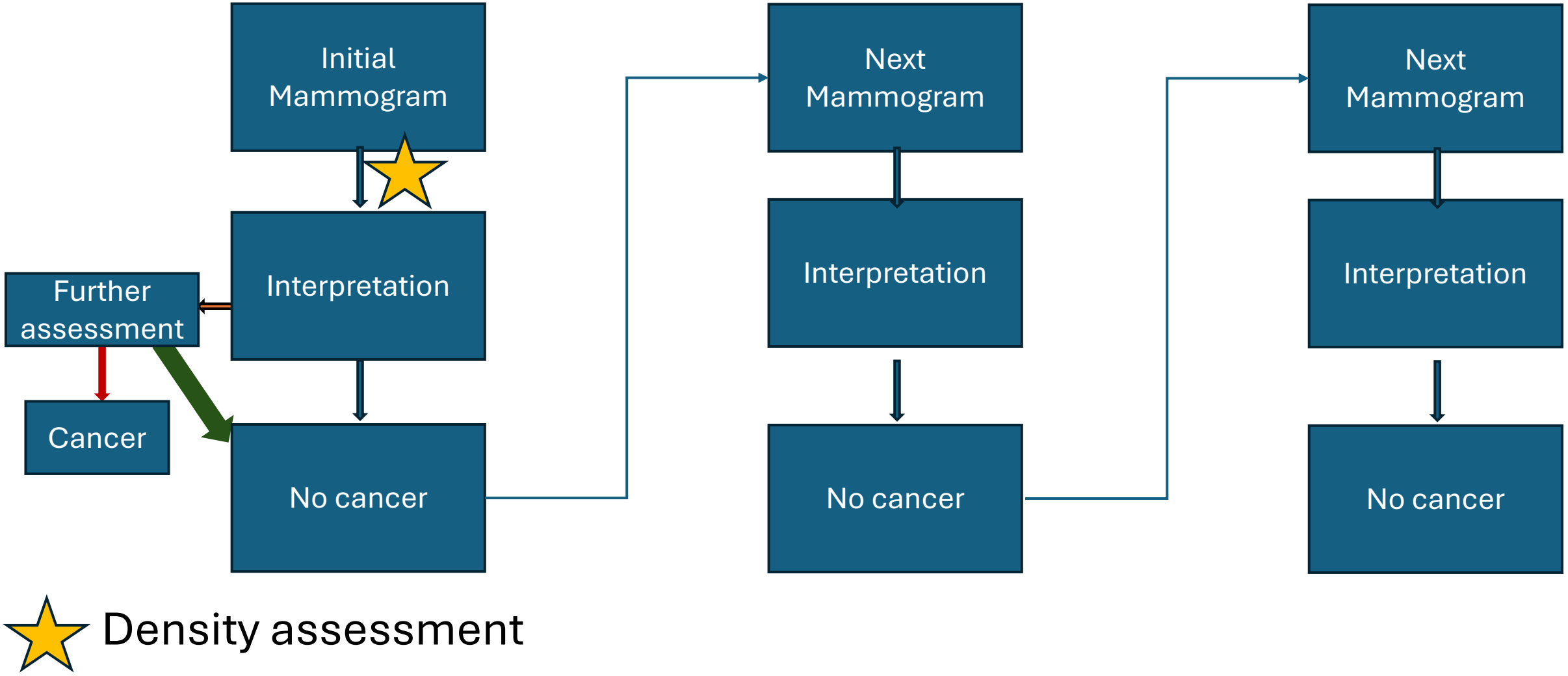


281/100k
Age 50-54

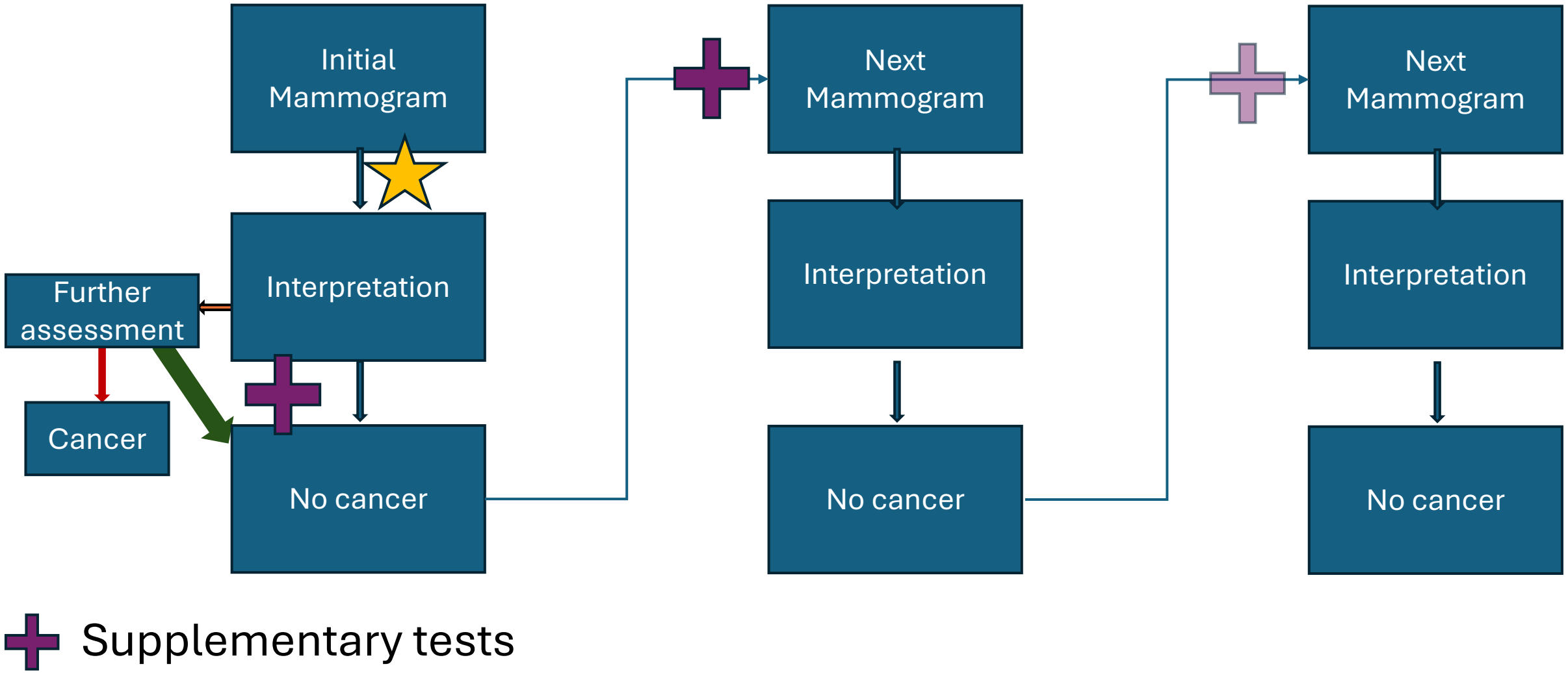
Incidence of cancer increases and breast density reduces with age

407/100k
Age 65-69

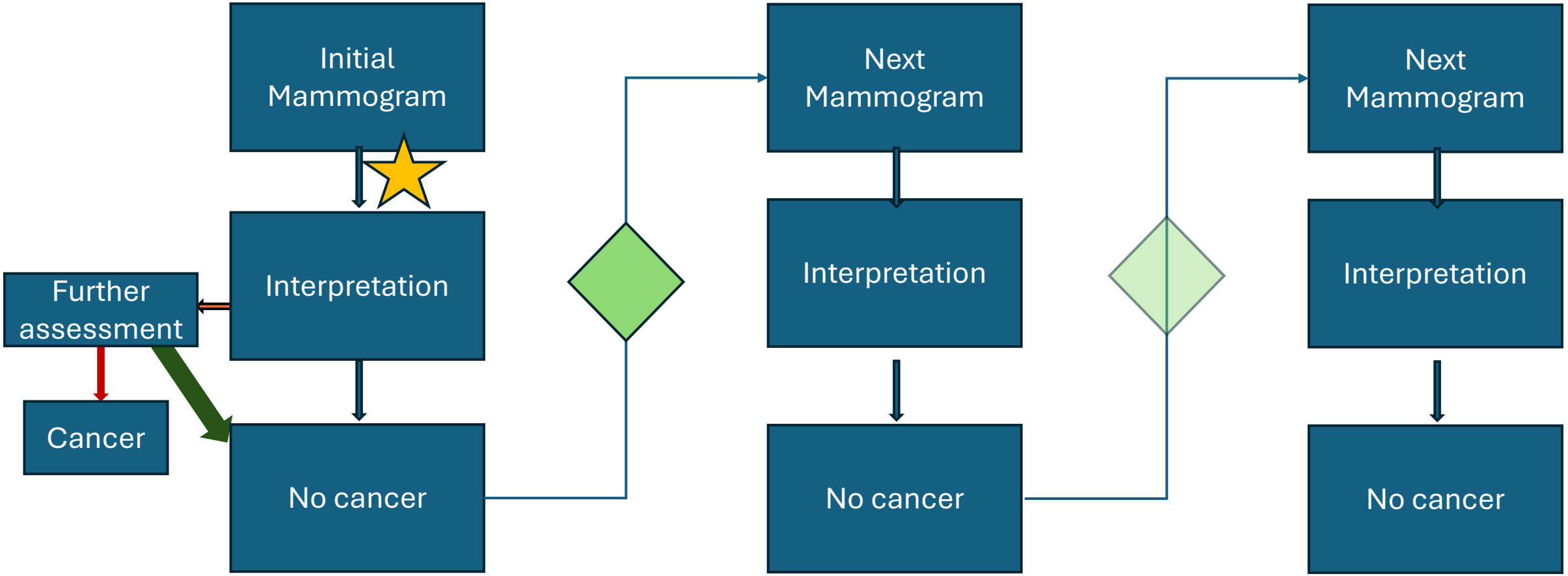
Examples of Pathway with risk adapted screening



Examples of Pathway with risk adapted screening

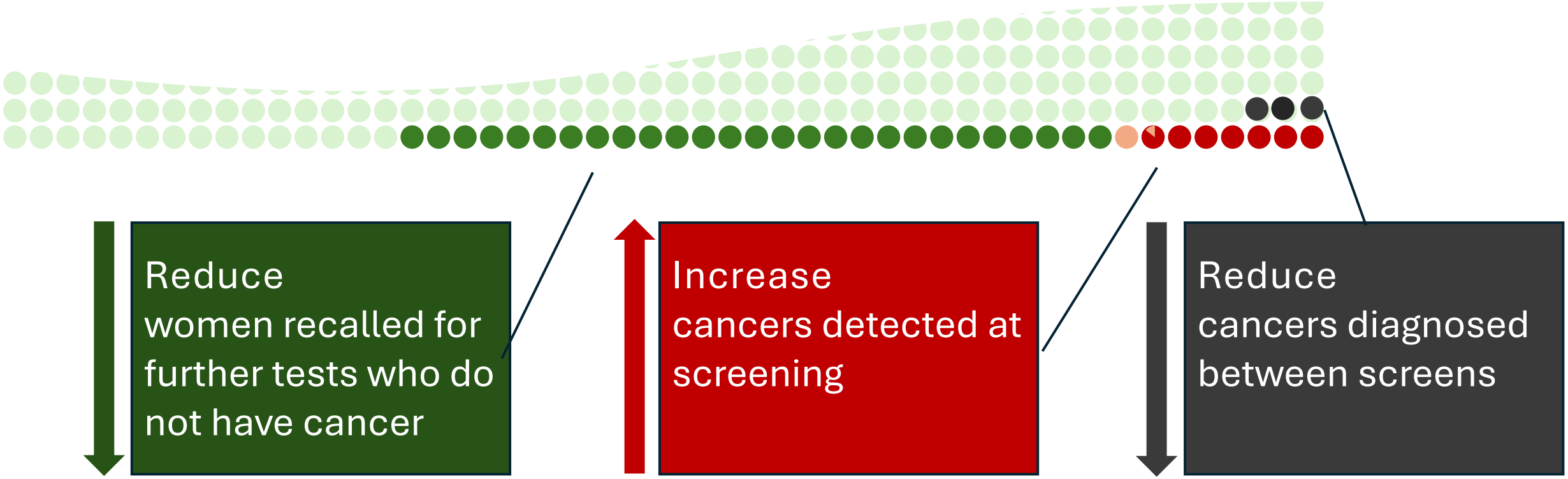


Examples of Pathway with risk adapted screening



Change screening interval (+/- test)

Change in screening protocol should aim to:



Cancers are not all the same:
Minimise overdiagnosis and overtreatment

Challenges of scaling
How should we measure breast density?

We should avoid:

- Increasing workload for readers
- Inconsistency between
  - Mammogram machines
  - Calculation methods
  - Readers
- Variation with systems
  - Changes in behaviour
  - Software upgrades
- Introducing inequality
  - Between subgroups
  - By postcode

We should consider:

- Automation
  - Consistent and reproducible
  - %MD or Fibroglandular volume
- Stable system
  - Minimise intervention
- Evaluate outcomes
  - Apply learning
- Interaction with AI
  - Identifying cancer in dense breasts
  - New ways of predicting risk