

# Screening vs Diagnostic Breast Imaging

Dr Cara Odenthal  
BreastScreen  
Qscan



## Learning Objectives

- Describe the difference between diagnostic and screening imaging of the breasts.
- Understand the role of supplementary imaging modalities in breast cancer screening.
- List the advantages and disadvantages of commonly utilised imaging modalities in breast imaging.



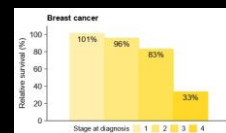
## What is screening?

WHO:  
Presumptive identification of unrecognized disease or defects by means of tests, examinations or other procedures that can be **applied rapidly**.

Intended for all people, in an identified target population, who **do not have symptoms** of the disease or condition being screened for.

Aims to reduce the **burden of the disease** in the community, including incidence, morbidity or mortality.

Overall benefits should outweigh any harms.



## BreastScreen Australia

Target age 50-74yo

Screening has been shown to reduce mortality *for average risk women*

Women eligible from 40yo (but no reminder letter)

Biennial

Eligible for annual screening if:

- 1° female relative diagnosed with breast Ca <50yo
- 1° male relative diagnosed with breast Ca at any age
- Personal Hx breast Ca (>5yrs from Dx)
- Previous ADH, ALH or LCIS on Bx



## BreastScreen Australia

- Conventional 2D MLO & CC mammo
- Read by 2 independent readers
  - One must be a radiologist
  - Arbitration by a single expert reader (>5yrs experience)
- Abnormalities worked up at assessment clinic
- Rigorous data collection
- Participation target 70% 50-69yo

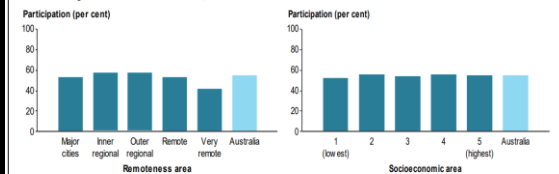


## BreastScreen Australia: Key Figures

- BreastScreen Australia Monitoring Report 2021 (age 50-74)
  - Participation rate ~54.8%
  - Assessment rate 11.7% after first screen, 3.7% after subsequent screen
- In 2019:
  - Ca detection rate 59.2 per 10,000
  - 59.8% had small Ca (<15mm)
  - DCIS detection rate 13.7 per 10,000

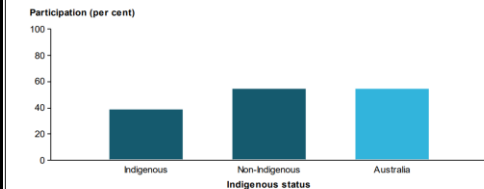


Figure 3.7: Participation of women aged 50-74 in BreastScreen Australia, by remoteness area, and by socioeconomic area, 2018-2019



Source: AIHW analysis of BreastScreen Australia data. Data for this figure are available in tables A3.5 and A3.6

Figure 3.8: Participation of women aged 50–74 in BreastScreen Australia, by Indigenous status, 2018–2019



Source: AIHW analysis of BreastScreen Australia data. Data for this figure are available in Table A3.8.

## Screening Mammography

Organized mammography screening programs and services



Loberg M, Lousdal ML, Bretthauer M and Kjauger M. Benefits and harms of mammography screening. Breast Cancer Res. 2015; 17(1): 63.

## Screening Programs

- Aus: Biennial mammo 40-74yo
- NZ: Biennial mammo 45-79yo
- UK: Triennial mammo 50-71yo
- The Netherlands: Biennial mammo 50-75yo
- Austria: Biennial mammo 45-69yo
- France: Biennial mammo 50-74yo
- Germany: Biennial mammo 50-69yo
- Canada: Biennial mammo 50-74yo
- USA: No centrally organised (funded) screening program



## Screening Recommendations



| Institution                                                                  | Recommendation for women aged 40 - 49 years old                     | Screening interval                                                     | Recommendation for women aged 70+                   |
|------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------|
| <b>North American organisations</b>                                          |                                                                     |                                                                        |                                                     |
| U.S. Preventive Services Task Force (2016) <sup>7</sup>                      | Shared decision making                                              | Every 2 years                                                          | Up to age 74                                        |
| American College of Obstetricians and Gynecologists (2017) <sup>8</sup>      | Shared decision making                                              | 1 to 2 years, after informed decision making                           | At least to age 75                                  |
| American College of Physicians (2019) <sup>9</sup>                           | Shared decision making                                              | Every 2 years                                                          | Up to age 74                                        |
| American Cancer Society (2015) <sup>6</sup>                                  | 40 - 44 Shared decision making<br>45 - 49 Screen                    | 1 year 45 - 54<br>1 to 2 years 55+                                     | If life expectancy > 10 years                       |
| American College of Radiology (2017) <sup>10</sup>                           | Screen                                                              | Every year                                                             | Individualize to current health and life expectancy |
| Canadian Preventive Task Force on Preventive Healthcare (2016) <sup>11</sup> | Do not screen                                                       | 2 to 3 years                                                           | Up to age 74                                        |
| <b>European organisations</b>                                                |                                                                     |                                                                        |                                                     |
| European Commission Initiative on Breast Cancer (2016) <sup>12</sup>         | 40 - 44 do not screen (conditional)<br>45 - 49 screen (conditional) | 45 every 2 - 3 years<br>50 - 69 every 2 years<br>70 - 74 every 3 years | Up to age 74                                        |
| NHS England <sup>13</sup>                                                    | Not included in breast cancer screening programme                   | Every 3 years                                                          | Up to age 71                                        |
| Portugal (Despacho n.º 8254/2017) <sup>14</sup>                              | Do not screen                                                       | Every 2 years                                                          | No                                                  |

Hakero, Bruno & Dias, Catarina & Martins, Cláudia & Jacinto, Nuno & Cadilha, Luis & Santos, Paulo. (2023). Rethinking the Choosing Wisely Portugal Recommendation on Breast Cancer Screening. Acta Médica Portuguesa. 34, 721, 10.30344/amp.18849

## Recent Screening Recommendations

- **USA**
  - ACR: recommends annual mammo from 40yo (2023)
  - SBI: recommends annual mammo from 40yo
  - USPSTFL recommends biennial mammo from 40yo (2024)
- **Europe**
  - European Council: recommendations updated to encourage the use of tomo for all breast cancer screening (2022)



## Screening Controversies

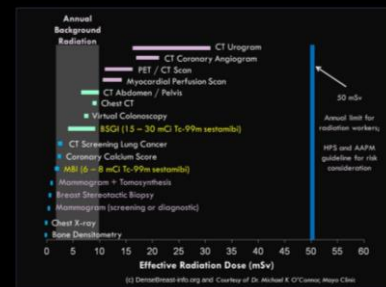
### Benefits

- Reduce mortality
- Allows less invasive treatment
- Positive psychologic effect



### Harms

- Overdetection
- False positives
- False negatives
- Radiation exposure
- Negative psychological effects



From: <https://doseradiationcanada.ca/what-are-the-facts-about-radiation-and-mammograms/>

## False Positives

- Risk in literature ranges from 20% (EU) – 30% (US)
- Issues:
  - Psychological impact
  - Cost of unnecessary investigation (& Rx)
  - Changes in health behaviour
    - Reduced trust in health care system
    - Less likely to reattend for screening?

Liberg M, Lewstam ML, Brattbaker M and Kallager M. Benefits and harms of mammography screening. Breast Cancer Res. 2016; 17(1): 63.



| Category 5 - DIAGNOSTIC IMAGING SERVICES                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12000                                                                                                                                                                                  | Group: 03 - Diagnostic Radiology<br>Subgroup: 10 - Radiographic Examination Of Breasts<br>Mammography of both breasts if there is reason to suspect the presence of malignancy because of:<br>(a) the past occurrence of breast malignancy in the patient, or<br>(b) significant history of breast or ovarian malignancy in the patient's family, or<br>(c) symptoms or indications of breast disease found on examination of the patient by a medical practitioner (5) |
| Note: These items are intended for use in the investigation of a clinical abnormality of the breasts and NOT for individual, group or opportunistic screening of asymptomatic patients |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Category 5 - DIAGNOSTIC IMAGING SERVICES |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12002                                    | Group: 03 - Diagnostic Radiology<br>Subgroup: 10 - Radiographic Examination Of Breasts<br>Three dimensional tomosynthesis of both breasts, if there is reason to suspect the presence of malignancy because of:<br>(a) the past occurrence of breast malignancy in the patient, or<br>(b) significant history of breast or ovarian malignancy in the patient's family, or<br>(c) symptoms or indications of breast disease found on examination of the patient by a medical practitioner |

## Diagnostic Breast Imaging

**Diagnostic = symptomatic**

Any age

No rebate privately (public clinics essentially nonexistent...)

Referral required

Standard mammo + other tests



## Diagnostic imaging

- Symptomatic patients:
  - New lump
  - Breast or nipple asymmetry
  - Skin changes (redness, dimpling)
  - Nipple change
  - Nipple discharge
  - Unilateral/focal breast pain
- Imaging forms part of the **triple test**



## Triple test

- Consists of:
  1. Medial history, clinical breast examination
  2. Imaging: mammography +/- US
  3. Non-excisional biopsy
- Aims:
  - Maximise diagnostic accuracy
  - Maximise preoperative diagnosis of breast Ca
  - Minimise excisional biopsies



## Pathway: new breast symptom <35yo

- Suspicious symptom: palpable mass, nipple change, skin change
  - → **ultrasound**
- Non-suspicious symptom: no palpable lump, likely hormonal change
  - Observe 6-8 weeks
  - If still present → **ultrasound**
- If looks benign → no further lx / surveillance USS
- If equivocal → biopsy
  - → if malignant on Bx → **mammogram**
- If looks malignant → **mammogram** → biopsy



## Pathway: new breast symptom ≥35yo

- Suspicious symptom: palpable mass, nipple change, skin change
  - → **mammogram** (unless breastfeeding or lactating)
- Non-suspicious symptom: no palpable lump, likely hormonal change
  - Observe 6-8 weeks
  - If still present → **mammogram + ultrasound**
- If looks benign → no further lx or continue screening
- If looks malignant or equivocal → biopsy



## Pathway: nipple discharge

- Clinical assessment + cytology
- If high risk → **mammogram** (if >35) + **ultrasound** + **surgical referral**
  - Age >60yo
  - Serous / bloody discharge
  - Spontaneous
  - Single duct
  - Abnormal examination
- If low risk → screening mammo if due, 2-3 month clinical review
  - Bilateral
  - Only on expression
  - Age <60yo
  - Normal examination



## Diagnostic pathways

- Cancer Australia
  - <https://www.cancer australia.gov.au/cancer-types/breast-cancer/clinicians-hub/gp-guides-and-resources>
- Radiology Across Borders (formerly Diagnostic Imaging Pathways)
  - [https://radiologyacrossborders.org/diagnostic\\_imaging\\_pathways/imaging-pathways/breast-imaging](https://radiologyacrossborders.org/diagnostic_imaging_pathways/imaging-pathways/breast-imaging)



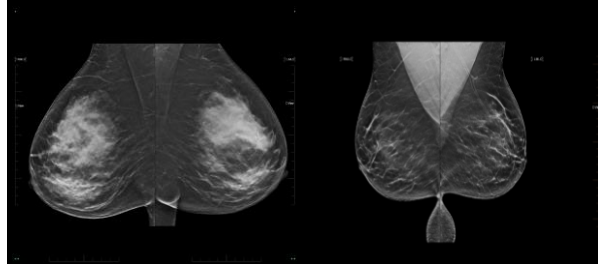
## Increased risk of breast cancer

- Risk factors:
  - Female
  - Increasing age
  - Unopposed oestrogen
  - Family Hx
  - Previous high-risk lesion
  - Alcohol
  - Previous chest XRT
  - Genetic mutations
- Density is an *independent* risk factor



Stallings et al. Mammographic density and breast cancer risk in breast screening assessment: status and women with a family history of breast cancer. 2018. EJC, vol 36, suppl 5.

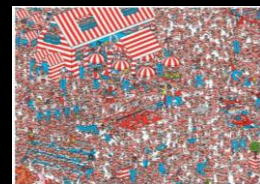
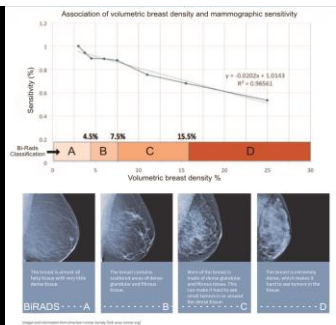
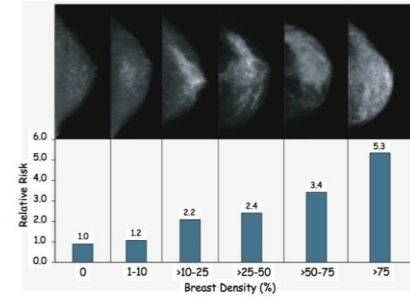
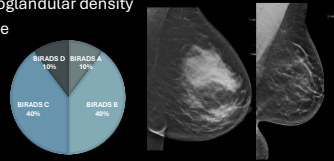
## Density

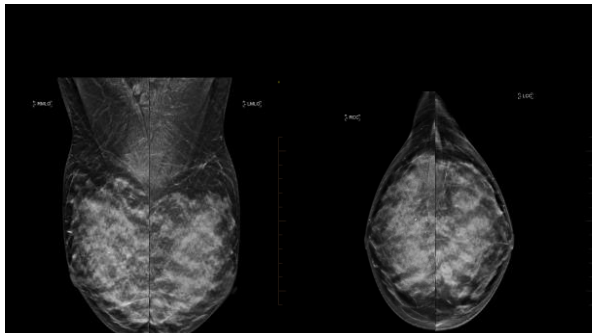
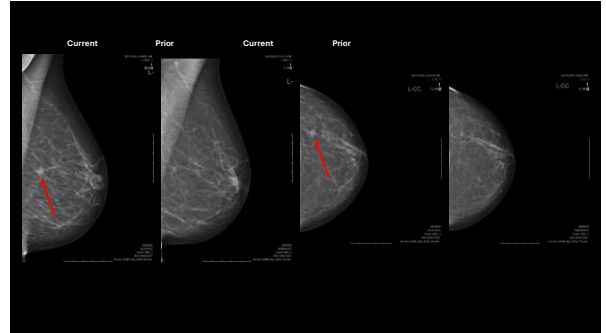


## BI-RADS

The American College of Radiology's Breast Imaging Reporting and Data System (BI-RADS):

- **A:** almost entirely fat
- **B:** scattered areas of fibroglandular density
- **C:** heterogeneously dense
- **D:** extremely dense



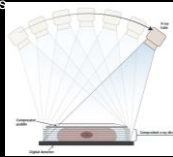


## Supplementary Imaging

- Conventional mammogram
  - Tomosynthesis
  - Contrast enhanced mammography
  - Ultrasound
  - MRI with contrast

## Tomosynthesis

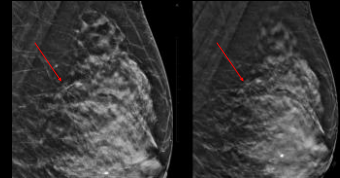
- “3D” mammography
- Patient positioning the same
- Xray arm sweeps in an arc
- Software reconstructs into 0.5mm-1mm slices
- Benefits:
  - Reduces tissue overlap
  - Better definition of lesion margins
  - **Very helpful for dense breasts!**



[https://www.cupm.org/content/56/7/523/figs/figs\\_data](https://www.cupm.org/content/56/7/523/figs/figs_data)

## Tomosynthesis

- Advantages (cf 2D)**
- Improved Ca detection
  - Reduced recall rate from screening
- Disadvantages**
- Not physiologic
  - Still affected by summation
  - Ionising radiation

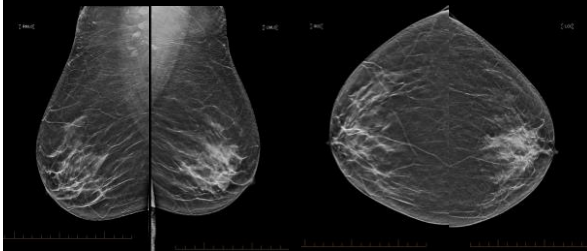


Bali et al. Breast cancer characteristics associated with 3D Digital Mammography versus Digital Breast Tomosynthesis for screening-detected and interval cancers. *Radiology*. Volume 263, Number 1, April 2013

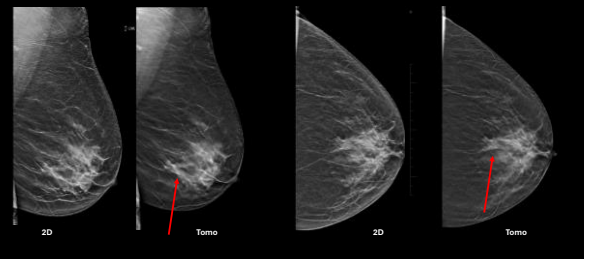
Conant et al. Mammographic Screening in Routine Practice: Multicase Study of Digital Breast Tomosynthesis and Digital Mammography Screening. *Radiology*. 2022; 307(2):e211071



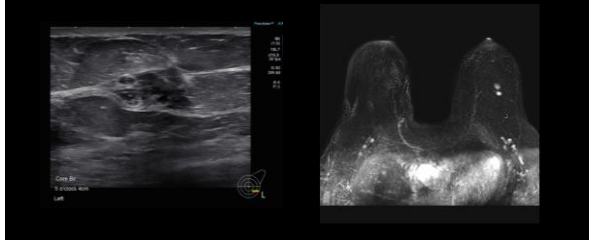
## Tomosynthesis: Case Example



## Tomosynthesis: Case Example



## Tomosynthesis: Case Example



### Pilot trial of digital breast tomosynthesis (3D mammography) for population-based screening in BreastScreen Victoria

Correspondence: T. Carver-Cox<sup>1</sup>, Nicholas O'Brien<sup>2</sup>, Lisa Robinson<sup>3</sup>, David Taylor<sup>4</sup>, Benjamin T. Hill<sup>5</sup>, Anna Macaskill<sup>6</sup>

<sup>1</sup>University of Melbourne, <sup>2</sup>University of Melbourne, <sup>3</sup>University of Melbourne, <sup>4</sup>University of Melbourne, <sup>5</sup>University of Melbourne, <sup>6</sup>University of Melbourne

DOI: 10.1093/bjcp/ckz020

#### Abstract

**Objective:** To compare detection rates for tomosynthesis and standard mammography in a population-based screening trial.

**Design, setting:** Population-based screening trial in Victoria, Australia.

**Participants:** 10,000 women aged 50-69 years.

**Interventions:** Tomosynthesis and standard mammography.

**Measurements and Main Results:** Tomosynthesis showed a 10% increase in breast cancer detection rates compared to standard mammography. The detection rate for tomosynthesis was 10.6% (95% CI 10.1-11.1) compared to 9.6% (95% CI 9.1-10.1) for standard mammography. The difference was statistically significant (p < 0.001).

**Conclusion:** Tomosynthesis improved breast cancer detection rates in a population-based screening trial.

### Two-year follow-up of participants in the BreastScreen Victoria pilot trial of tomosynthesis versus mammography: breast density-stratified screening outcomes

Correspondence: T. Carver-Cox<sup>1</sup>, Nicholas O'Brien<sup>2</sup>, Lisa Robinson<sup>3</sup>, David Taylor<sup>4</sup>, Benjamin T. Hill<sup>5</sup>, Anna Macaskill<sup>6</sup>

<sup>1</sup>University of Melbourne, <sup>2</sup>University of Melbourne, <sup>3</sup>University of Melbourne, <sup>4</sup>University of Melbourne, <sup>5</sup>University of Melbourne, <sup>6</sup>University of Melbourne

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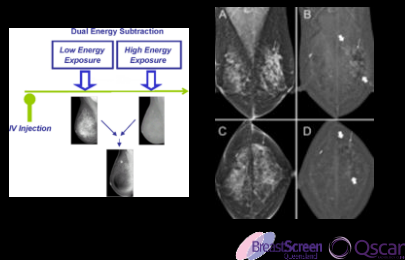
## Contrast-Enhanced Mammography

**Advantages**

- Morphology + physiology
- Great for dense breasts

**Disadvantages**

- No rebate (yet!)
- Risk of allergy
- Ionising radiation
- Doesn't visualise axilla & chest wall



### American College of Radiology Launches Contrast-Enhanced Mammography Imaging

Contrast-enhanced mammography for the assessment of screening recalls: a two-centre study

Correspondence: T. Carver-Cox<sup>1</sup>, Nicholas O'Brien<sup>2</sup>, Lisa Robinson<sup>3</sup>, David Taylor<sup>4</sup>, Benjamin T. Hill<sup>5</sup>, Anna Macaskill<sup>6</sup>

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#### Abstract

**Objective:** To evaluate the potential of contrast-enhanced mammography (CEM) for reducing the number of screening recalls.

**Design, setting:** Population-based screening trial in Victoria, Australia.

**Participants:** 10,000 women aged 50-69 years.

**Interventions:** CEM and standard mammography.

**Measurements and Main Results:** CEM showed a 16% reduction in breast cancer detection rates compared to standard mammography. The detection rate for CEM was 16.4% (95% CI 15.9-16.9) compared to 15.0% (95% CI 14.5-15.5) for standard mammography. The difference was statistically significant (p < 0.001).

**Conclusion:** CEM improved breast cancer detection rates in a population-based screening trial.

### Rapid Access to Contrast-Enhanced Spectral Imaging in Women Recalled from Breast Screening: the RACER trial study design

Contrast-enhanced mammography for the assessment of screening recalls: a two-centre study

Correspondence: T. Carver-Cox<sup>1</sup>, Nicholas O'Brien<sup>2</sup>, Lisa Robinson<sup>3</sup>, David Taylor<sup>4</sup>, Benjamin T. Hill<sup>5</sup>, Anna Macaskill<sup>6</sup>

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## Ultrasound

- Complementary modality to mammography
- Provides additional information to mammogram
  - Localise & characterise mammographic abnormality
  - Identify lesions occult on mammogram
  - Reassurance breast tissue is normal
- 'Second look' after MRI
- Particularly useful in dense breasts
- Not validated for screening



## Ultrasound

### Advantages

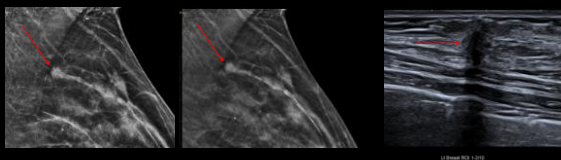
- Cheap
- No contrast
- No ionising radiation

### Disadvantages

- Highly user dependant
- Time consuming
- Not physiologic



## Ultrasound: Case Example



## Breast MRI

- Uses a magnetic field & radiowaves to produce images
- Complementary to mammogram & ultrasound
- Requires contrast (gadolinium)
- Indications:
  - Screening in high-risk population (eg BRCA1, BRCA2)
  - Known cancer: surgical planning, or post neoadjuvant
  - Evaluating implants
  - Dense breasts



## Breast MRI

### Advantages

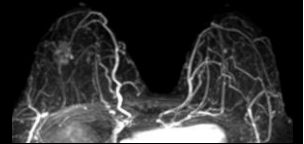
- Excellent structural detail
- Physiologic information
- Visualises chest wall & axillae
- Not ionising radiation

### Disadvantages

- Time consuming
- Uncomfortable
- Expensive
- Gadolinium contrast

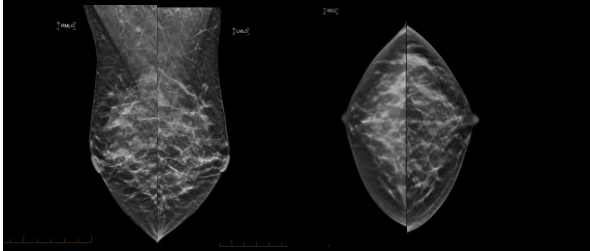
## Breast MRI

| Modality    | Sensitivity    | Specificity |
|-------------|----------------|-------------|
| Mammo       | 25-58%         | 93-100%     |
| USS         | 33-52%         | 91-98%      |
| Mammo + USS | 48-67%         | 89-98%      |
| MRI         | <b>71-100%</b> | 81-98%      |

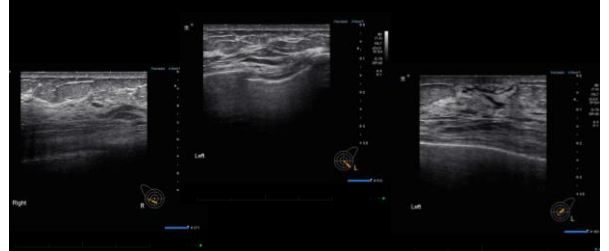


Siderelli et al. The paradox of MRI for breast cancer screening: high-risk and dense breasts— available evidence and current practice. *Imagines into Imaging* (2020) 15:56

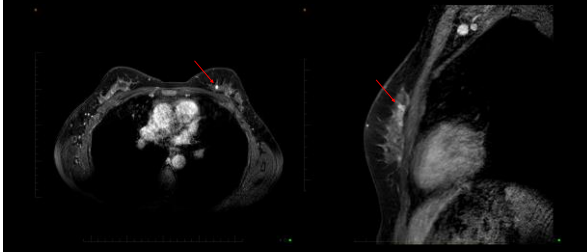
## MRI: Case Example



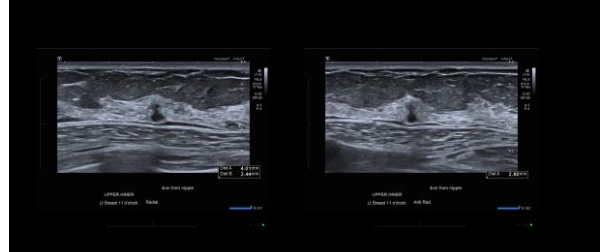
## MRI: Case Example



## MRI: Case Example



## MRI: Case Example



**Supplemental MRI Screening for Women with Extremely Dense Breast Tissue**

**Abstract**

**Background:** Supplemental breast MRI is a tool before the breast cancer screening for the detection of cancer with mammography. Data are needed on the use of supplemental magnetic resonance imaging (MRI) to improve early detection and reduce breast cancer deaths in high-risk patients.

**Methods:** In this multicenter, randomized controlled trial in the Netherlands, we assigned 40,000 women to the mammography or mammography plus supplemental MRI screening group.

**Results:** The supplemental MRI screening group had a significantly higher rate of breast cancer detection (16.5 per 1000) compared with the mammography group (8.5 per 1000). The rate of false positives was 9.7% in the supplemental MRI group and 8.5% in the mammography group.

**Conclusions:** The use of supplemental MRI screening in women with extremely dense breast tissue significantly increased the rate of breast cancer detection and reduced the rate of false positives.

**Netherlands:**  
Ca detection rate 16.5 per 1000  
8% false positives

**USA/Germany:**  
Ca detection rate 22.6 per 1000  
9.7% false positives

**BreastScreen Australia (2019):**  
Ca detection rate ~6 per 1000

**Category 3 - DIAGNOSTIC IMAGING SERVICES**

**Normal**  
**Abnormal**  
**BI-RADS 3 - Probable Benign**

**BI-RADS 3 - Probable Benign**

Effective of both breasts for the detection of cancer in a patient, if:

- (a) a dedicated breast unit is used; and
- (b) the request for the scan identifies that the patient is asymptomatic and is younger than 50 years of age; and
- (c) the request for the scan identifies that the patient is at high risk of developing breast cancer due to one or more of the following:
  - (i) genetic testing has identified the presence of a high risk breast cancer gene mutation in the patient or in a first degree relative of the patient;
  - (ii) one of the patient's first or second degree relatives was diagnosed with breast cancer at age 40 years or younger; and
  - (iii) another first or second degree relative on the same side of the patient's family was diagnosed with breast cancer at age 40 years or younger;
  - (iv) the patient has a personal history of breast cancer before the age of 50 years;
  - (v) the patient has a personal history of axillary node resection;
  - (vi) the patient has a history of radiation therapy;
  - (vii) the patient has a history of radiation therapy greater than 15% in a 10 year absolute risk estimation greater than 1% using a clinically relevant risk estimation algorithm; and
  - (viii) the service is not performed in conjunction with item 50373 or 50379.

**Sub-Item 50373**

**Notes:**

Item 50373 is payable 70% = \$664.75 (80% = \$613.16)

(See also 50373, 50379, 50380, 50381, 50382, 50383, 50384, 50385, 50386, 50387, 50388, 50389, 50390, 50391, 50392, 50393, 50394, 50395, 50396, 50397, 50398, 50399, 50400, 50401, 50402, 50403, 50404, 50405, 50406, 50407, 50408, 50409, 50410, 50411, 50412, 50413, 50414, 50415, 50416, 50417, 50418, 50419, 50420, 50421, 50422, 50423, 50424, 50425, 50426, 50427, 50428, 50429, 50430, 50431, 50432, 50433, 50434, 50435, 50436, 50437, 50438, 50439, 50440, 50441, 50442, 50443, 50444, 50445, 50446, 50447, 50448, 50449, 50450, 50451, 50452, 50453, 50454, 50455, 50456, 50457, 50458, 50459, 50460, 50461, 50462, 50463, 50464, 50465, 50466, 50467, 50468, 50469, 50470, 50471, 50472, 50473, 50474, 50475, 50476, 50477, 50478, 50479, 50480, 50481, 50482, 50483, 50484, 50485, 50486, 50487, 50488, 50489, 50490, 50491, 50492, 50493, 50494, 50495, 50496, 50497, 50498, 50499, 50500, 50501, 50502, 50503, 50504, 50505, 50506, 50507, 50508, 50509, 50510, 50511, 50512, 50513, 50514, 50515, 50516, 50517, 50518, 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50662, 50663, 50664, 50665, 50666, 50667, 50668, 50669, 50670, 50671, 50672, 50673, 50674, 50675, 50676, 50677, 50678, 50679, 50680, 50681, 50682, 50683, 50684, 50685, 50686, 50687, 50688, 50689, 50690, 50691, 50692, 50693, 50694, 50695, 50696, 50697, 50698, 50699, 50700, 50701, 50702, 50703, 50704, 50705, 50706, 50707, 50708, 50709, 50710, 50711, 50712, 50713, 50714, 50715, 50716, 50717, 50718, 50719, 50720, 50721, 50722, 50723, 50724, 50725, 50726, 50727, 50728, 50729, 50730, 50731, 50732, 50733, 50734, 50735, 50736, 50737, 50738, 50739, 50740, 50741, 50742, 50743, 50744, 50745, 50746, 50747, 50748, 50749, 50750, 50751, 50752, 50753, 50754, 50755, 50756, 50757, 50758, 50759, 50760, 50761, 50762, 50763, 50764, 50765, 50766, 50767, 50768, 50769, 50770, 50771, 50772, 50773, 50774, 50775, 50776, 50777, 50778, 50779, 50780, 50781, 50782, 50783, 50784, 50785, 50786, 50787, 50788, 50789, 50790, 50791, 50792, 50793, 50794, 50795, 50796, 50797, 50798, 50799, 50800, 50801, 50802, 50803, 50804, 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## Learning Objectives

Describe the difference between diagnostic and screening imaging of the breasts.

Understand the role of supplementary imaging modalities in breast cancer screening.

List the advantages and disadvantages of commonly utilised imaging modalities in breast imaging.



## Challenges & future directions

Risk-stratified screening

- Individualised 'bespoke' screening becoming commonplace



## Questions?

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