

Contrast Enhanced Spectral Mammography

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How is Breast Cancer Detected?

Mammography is the most common way to screen for breast cancer.

If the radiologist sees an abnormality on a screening mammography, the patient is asked to return for additional imaging with mammography and possibly ultrasound or MRI.

These extra images help the radiologist determine whether the area in question is benign or malignant. These images can also help determine disease extent in a newly diagnosed breast cancer patient.

What is CESM?

Contrast Enhanced Spectral Mammography (CESM)

- New imaging tool FDA approved in 2011 for diagnostic imaging.
- Iodinated contrast is administered and then a dual energy four view mammogram is performed.
- Two images are acquired for each imaging position:
 1. **Low Energy**: appears similar to conventional mammography and can be used by radiologists in similar way
 2. **Recombined**: detects angiogenesis by highlighting contrast uptake in the breast, similar to a subtraction image on breast MRI

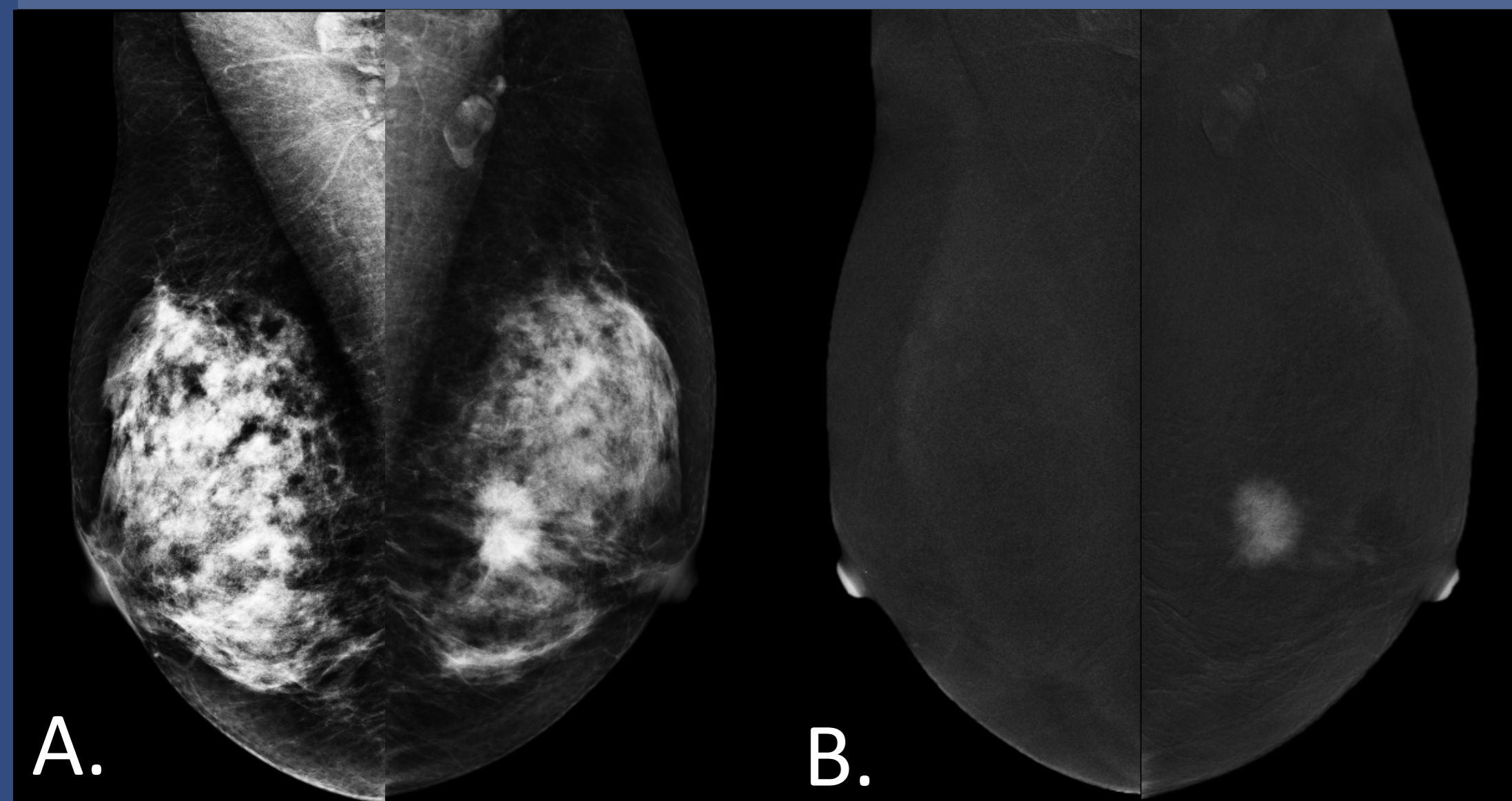


Figure 1.

- A. Routine mammogram images where overlapping dense breast tissue obscures the breast cancer.
- B. Recombined images showing spiculated enhancing mass with 2cm of non-mass enhancement extending towards the nipple, not appreciated on the routine mammogram.

Benefits of CESM

- In diagnostic setting:
 - **Increased sensitivity** relative to 2D imaging
 - **Equal sensitivity** and **improved specificity** relative to breast MRI
- No additional time above diagnostic mammogram other than IV placement and contrast administration
- Faster and less expensive than breast MRI
- Easy to implement into clinical practice
 - Software upgrade to commonly used mammography equipment
 - Staff training minimal

Imaging Test	Charges at BIDMC*
2D Mammogram (Screening)	\$813
3D Mammogram (Screening)	\$1013
2D Mammogram (Diagnostic)	\$862
3D Mammogram (Diagnostic)	\$1824
Breast Ultrasound	\$972
Contrast Enhanced Breast MRI	\$2224
CESM	\$882

*This does not reflect reimbursement rates by insurance or patient

How are we using CESM at BIDMC?

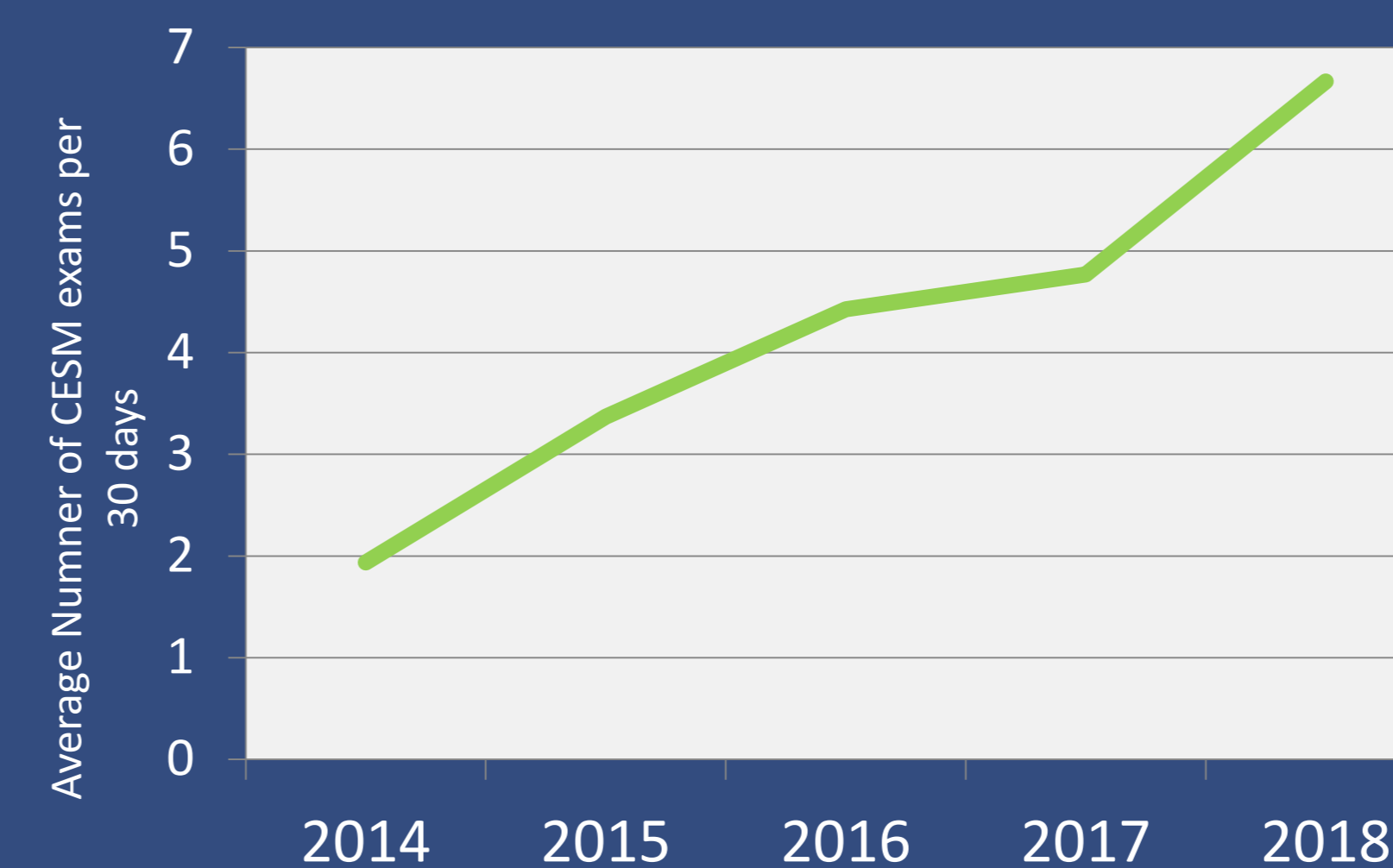


Figure 2. Average number of CESM exams per 30 days at BIDMC from 2014 to 2018

- Implemented for diagnostic use in January 2017
- Indications include: Extent of disease, call backs from screening, follow-up, clinical symptom, troubleshooting

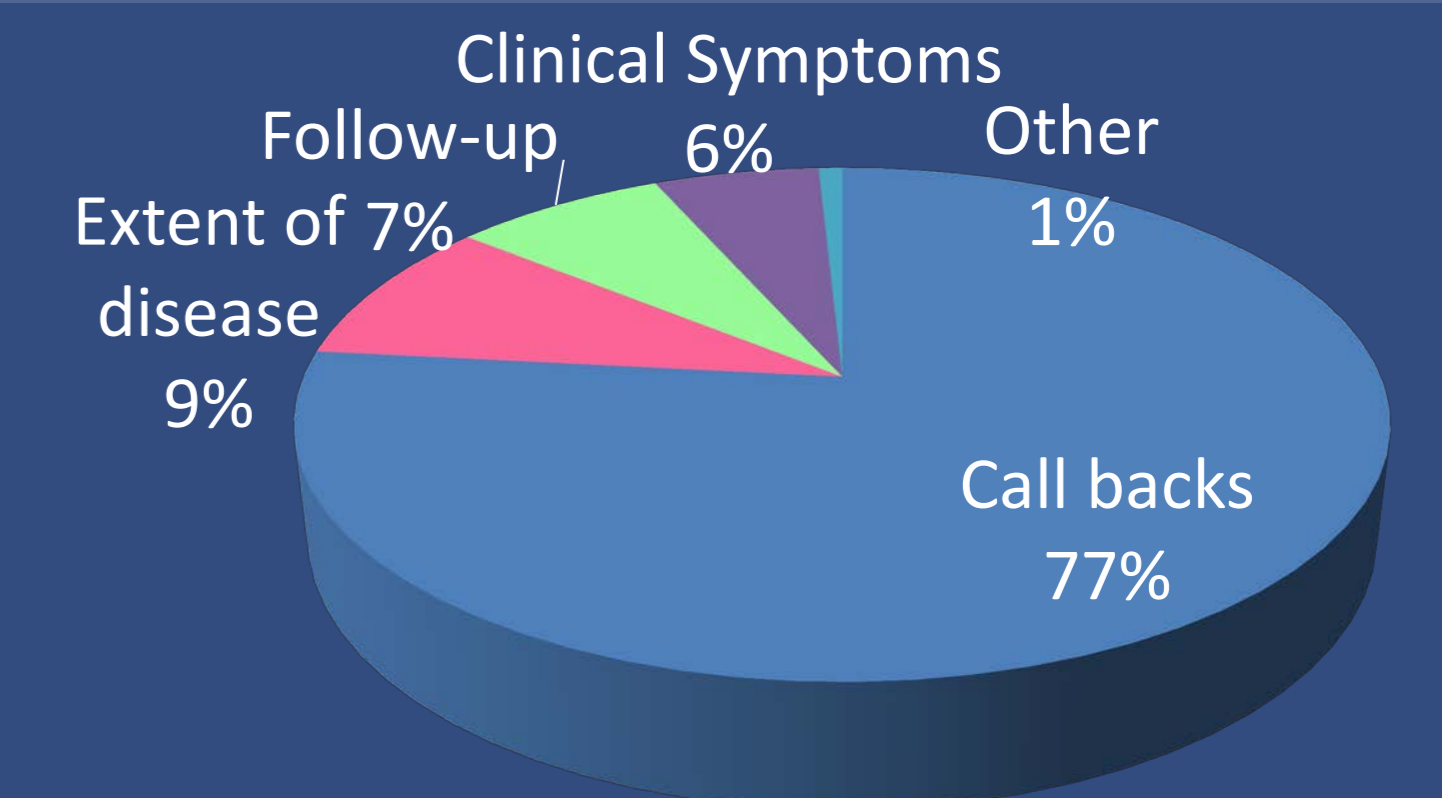


Figure 3. Diagnostic indications for 120 CESM cases at BIDMC from 2014 to 2018.

For more information, contact:

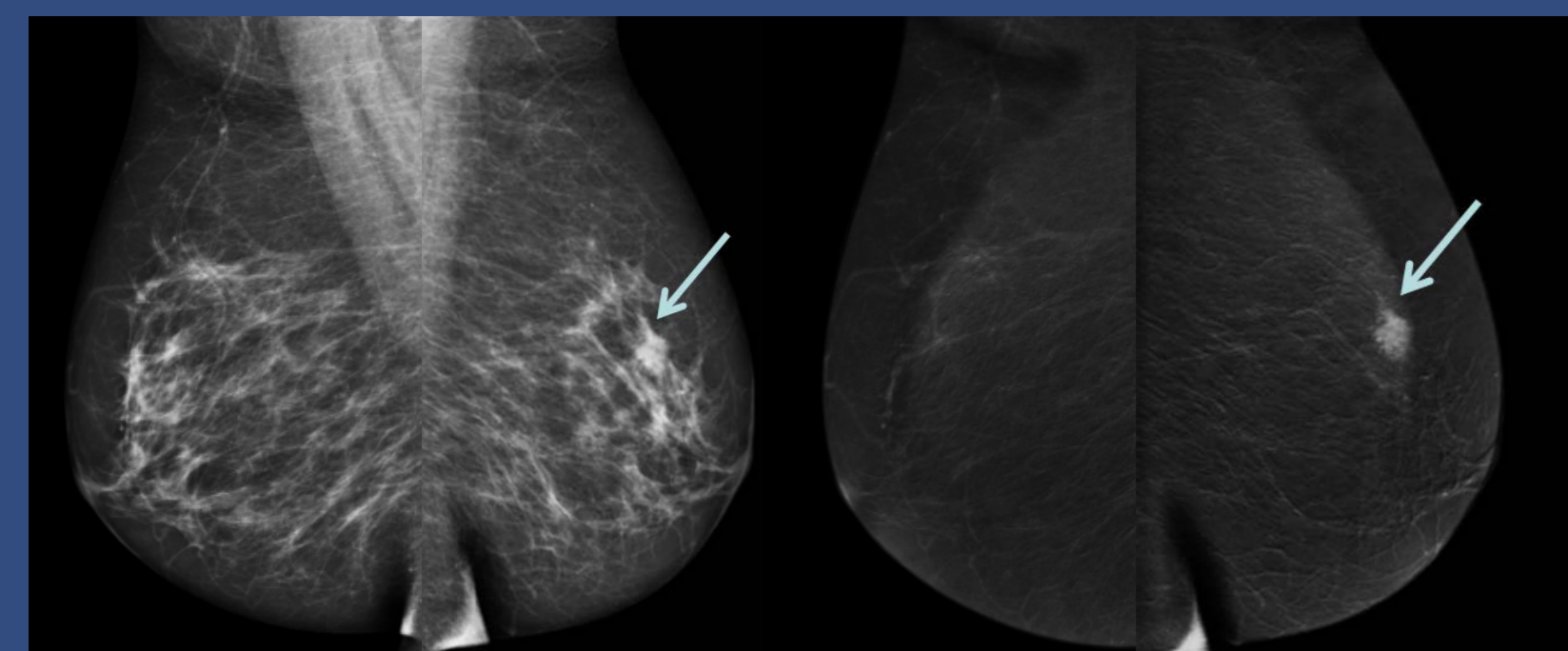
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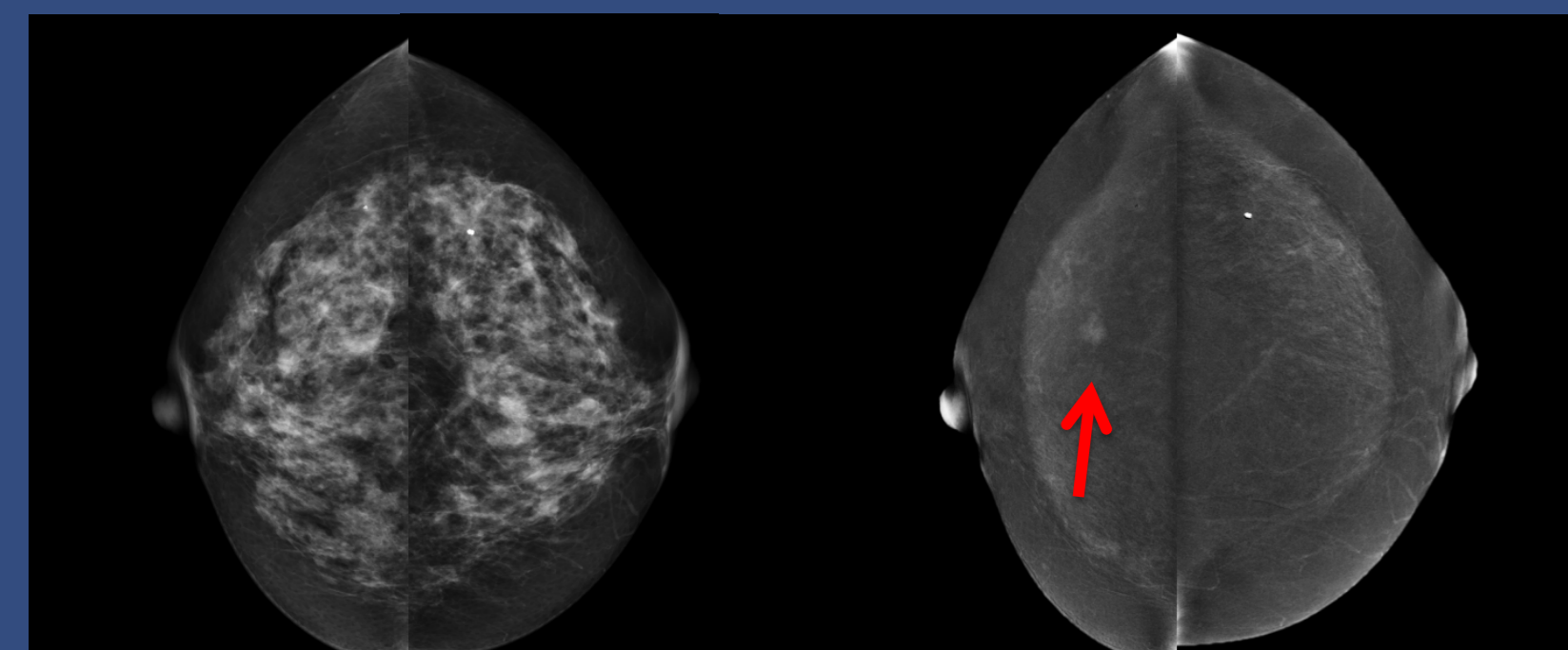
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Case Examples of CESM Use at BIDMC



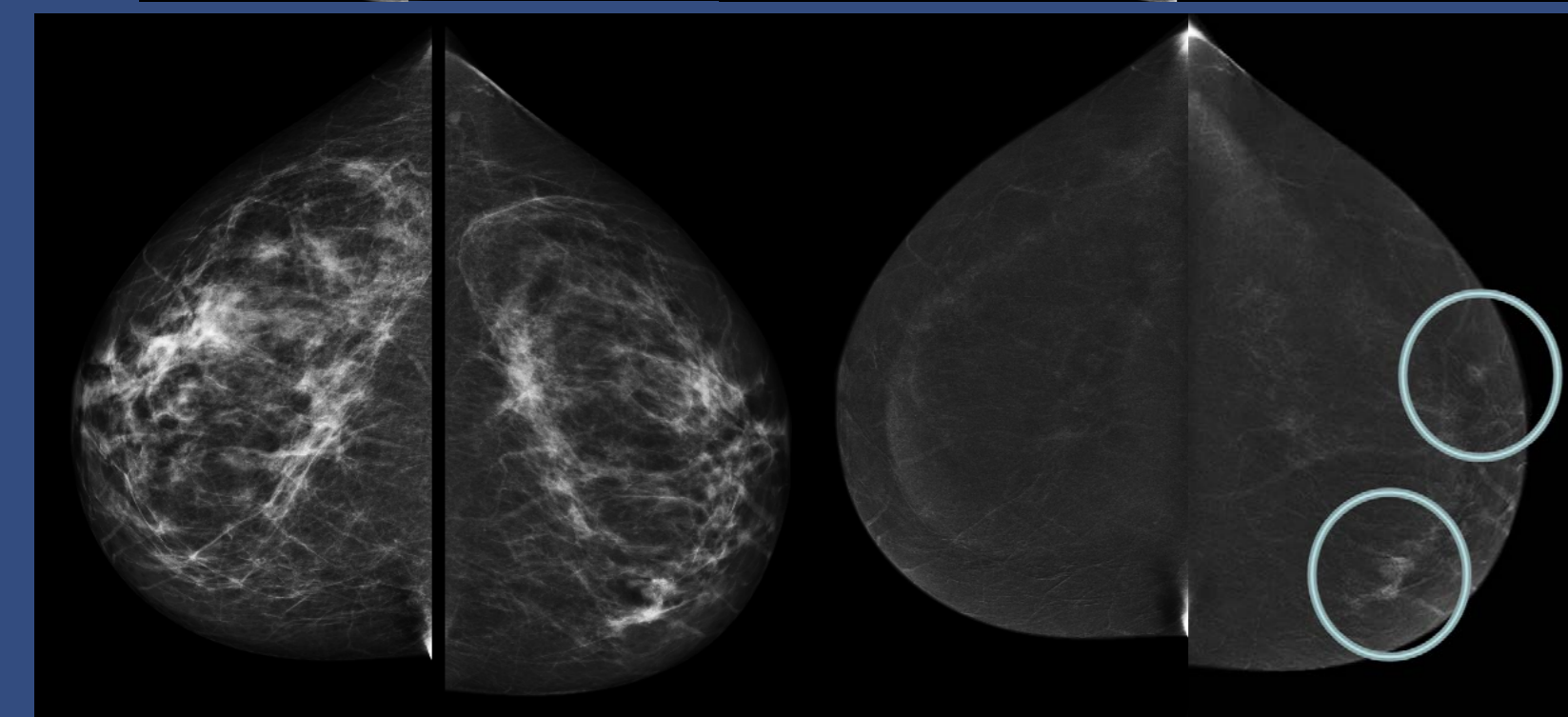
Case 1: Screen Detected Cancer

- Focal asymmetry seen on screening mammogram (light blue arrow)
- Returned for CESM, which showed enhancing mass in this location
- Rest of exam normal



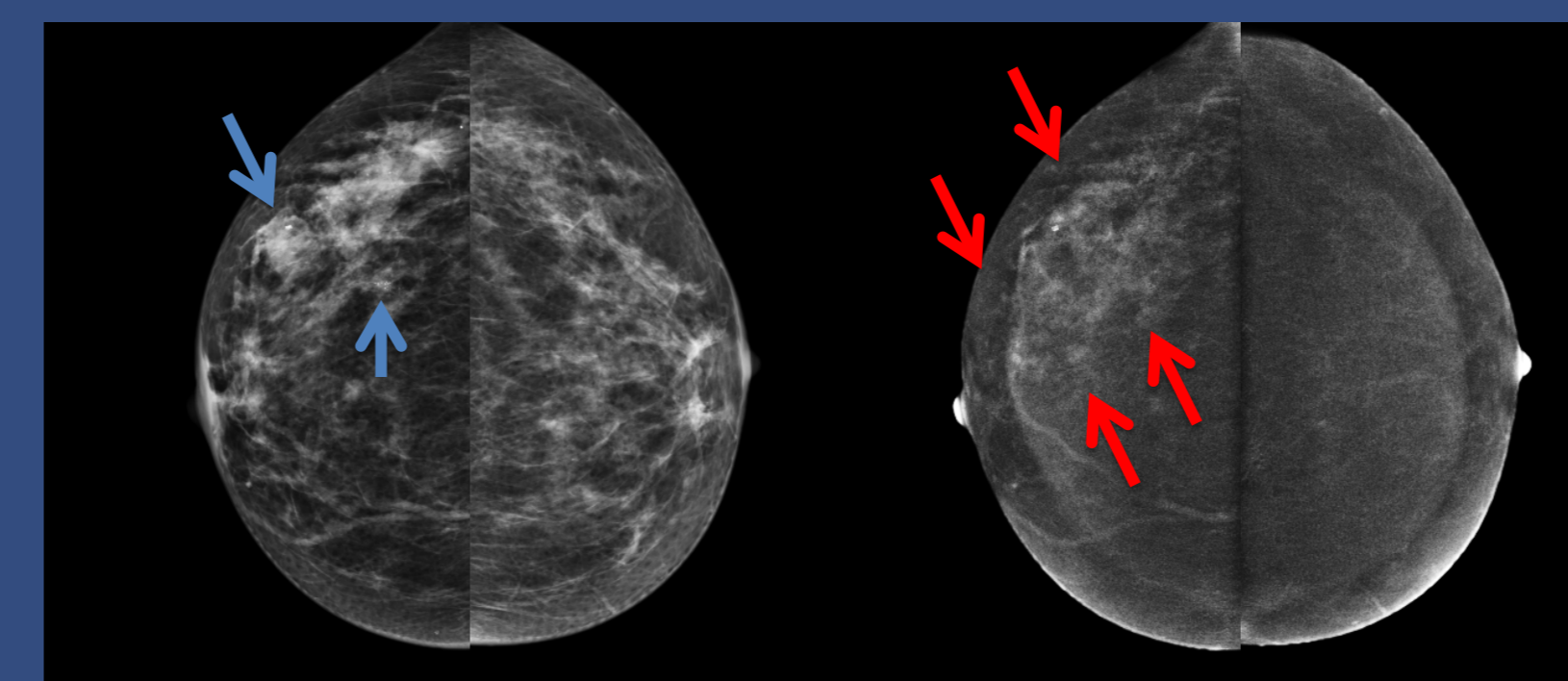
Case 2: Incidental Cancer

- Patient was called back from screening for left breast architectural distortion
- Left breast call-back was negative
- Incidental right breast cancer was found (red arrow)



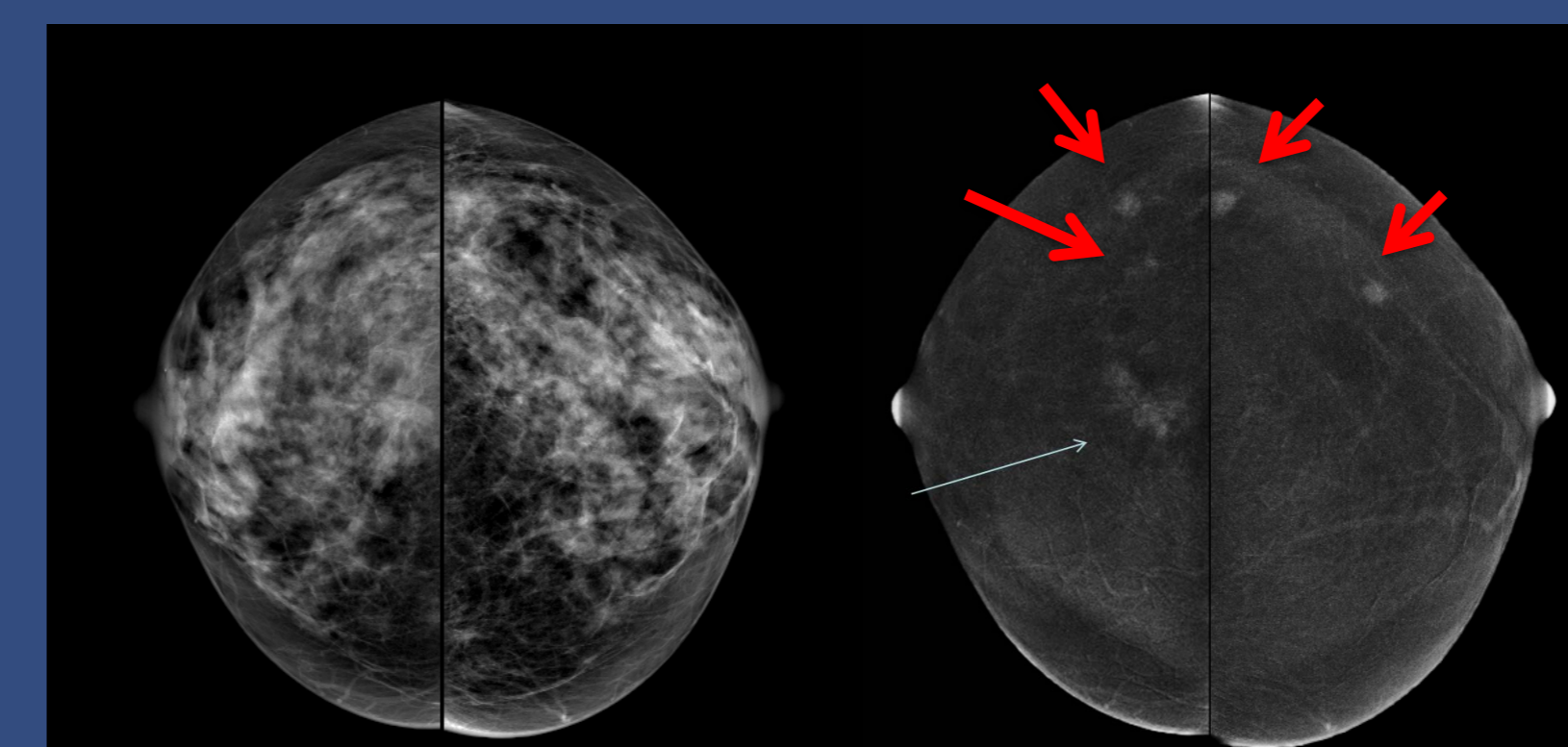
Case 3: Mammogram Only Found DCIS, CESM Found Invasive Cancer

- Called back for left breast calcifications in inner left breast, which was DCIS
- CESM shows an additional mass in the outer left breast not seen on the initial mammogram
- Additional mass was invasive cancer
- This confirmed multicentral disease



Case 4: CESM Shows Larger Area than Screening Mammogram

- Two discrete groups of suspicious calcifications are seen in the right breast. One was biopsied and shown to be DCIS (calcifications are marked with blue arrows).
- Recombined images show the area is much larger than the two groups and involves whole outer right breast (red arrows).



Case 5: Multiple Incidental Cancers in Both Breasts

- Patient was called back for an area of architectural distortion in the right breast (marked by arrow).
- At least four additional enhancing masses in the outer aspects of both breasts were found and biopsy proven to be malignancy. These were not seen on the conventional mammogram and tomosynthesis views.

Figure 4. CESM case examples from BIDMC, consisting of Low Energy (left) and Recombined Images (right).

Lessons Learned

- We are performing an ongoing audit of contrast enhanced diagnostic mammography in our clinical practice.
- By evaluating 64 diagnostic CESM performed at our academic institution from 2/11/16 – 2/7/17, we measured the cancer detection rate, positive predictive value, sensitivity and specificity of CESM at BIDMC when compared to Breast Cancer Surveillance Consortium (BCSC) benchmarks.

	BCSC Benchmarks	CESM at BIDMC
CDR (per 1000 exams)	30	265.6
PPV2	31.2%	63.0%
Sensitivity	83.1%	100%
Specificity	93.2%	78.7%

Next Steps

- To use CESM more routinely for new cancer patients to evaluate disease extent instead of MRI.
- To study the impact of CESM for diagnostic evaluation as it relates to timeliness, outcomes, and expense in patients with new cancer diagnosis and other breast abnormalities.
- To study CESM for breast cancer screening via a multi-case, multi-reader enriched research study at BIDMC entitled, "Contrast Enhanced Spectral Mammography vs. MRI for Breast Cancer Screening".

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