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AI in Breast Imaging: Automated Approach to Positioning

Key Take-a-ways from this presentation

- ✓ Mammography is changing rapidly from a "one-size fits all" screening environment to "personalized breast screening"
- ✓ The basics of good positioning and compression have become a critical component in this process.
- ✓ The introduction of EQUIP has "helped" mammography centers to understand the importance of analysis of positioning and compression.
- ✓ This presentation will address the issues of positioning and compression, breast density and how it will affect the image for the radiologist, and the evaluation of image quality using clinical analytics.

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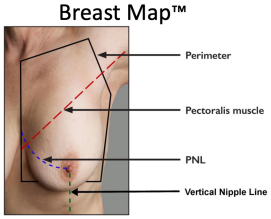
Breast Map™



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Key Take-a-ways from this presentation

- ✓ **You cannot change** what **you cannot measure**
- ✓ If **you measure** something, **you can** improve it
- ✓ Unless **you measure** something, **you do not know** if it is getting better or worse
- ✓ Fear of uncovering room for improvement should not prevent **you** from using metrics

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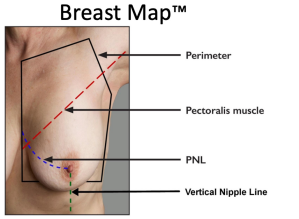
Breast Map™



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Key Take-a-ways from this presentation

Breast Imaging AI Checklist:

- ❑ How does it improve patient care?
- ❑ What is its regulatory status?
- ❑ What's the return on investment?
- ❑ How well can it integrate into your workflow?

Beyond the hype:

- ❑ *Is it explainable?*
- ❑ *Is it generalizable?*
- ❑ *Is it validated?*

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Why is breast imaging AI challenging?

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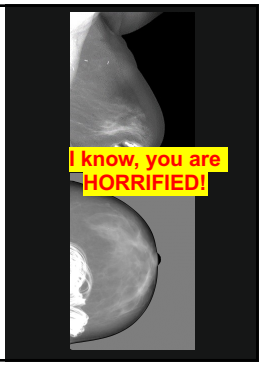
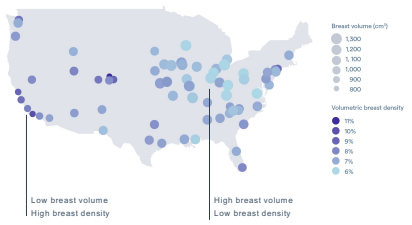
AI algorithms to be generalizable must work with a wide range of variables:

- Breast size and tissue composition
- X-ray machine types and settings
- Technologist factors, e.g., compression, positioning, artifacts
- Image processing (if not using raw x-ray images)



Challenge 1: each patient is unique



Data from Volpara Analytics.

- > 13M women attend a Volpara breast clinic annually.
- Volpara has collected 60M raw images, securely stored in the cloud.
- Volpara® Analytics™ enables analysis of that data to provide site-wide analytics and nationwide benchmarking.

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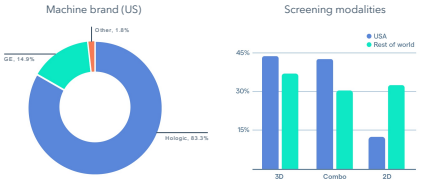
Challenge 2: vendor system variability



Data from 2021 onwards.

Each machine has different versions and settings. This presents a challenge for most AI to work across all of them.

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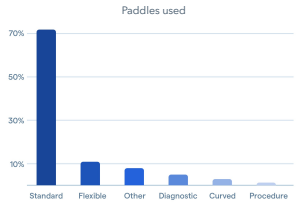
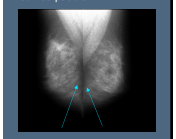
Challenge 3: variation from paddles



Data from 2021 onwards.

Paddles can create significant artifacts the AI must deal with—either slant across an image or other issues, such as this from a curved paddle:



Knowing the physics allows the user to correct for most issues prior to AI processing —that is computer vision.

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Challenge 4: technologist performance variation

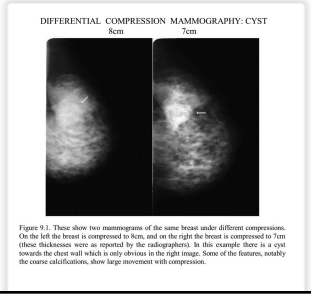
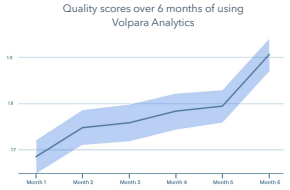


Figure 9.1. These show two mammograms of the same breast under different compressions. On the left the breast is compressed to 8cm, and on the right the breast is compressed to 7cm (these thicknesses were as reported by the radiographers). In this example there is a cyst towards the chest wall which is only obvious in the right image. Some of the features, notably the coarse calcifications, show large movement with compression.



Data from 2021 onwards. Measurement of ten mammogram technologists.

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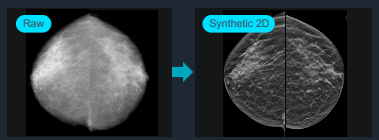
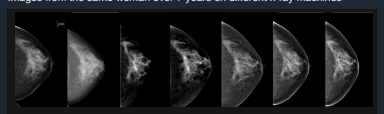
Challenge 5: image processing differences



Images from the same woman over 7 years on different x-ray machines



- X-ray manufacturers process 2D/3D images in different, proprietary ways.
- Processing variability due to manufacturer, model, and site makes it difficult to get AI to work and be generalizable on "Presentation Images".
- If pixel value is required for quantification reasons, raw data is needed.

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AI use cases today: displaying the quantitative science

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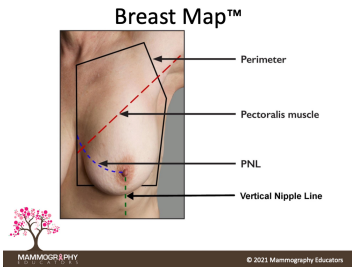
Data is not just data - Understanding data is key

We focus on repetitive quantification tasks:

- Breast density
- Positioning metrics
- Breast compression metrics
- Radiation dose

Quantification provides the ability to explain and allows for a range of validation tests - **This drives trust in an AI algorithm**



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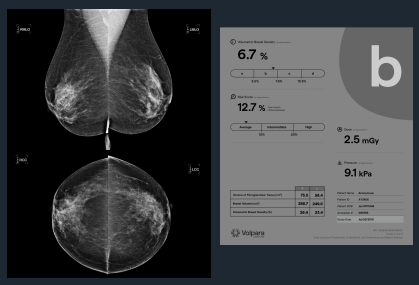
Driving consistency in breast density reporting



- Our job is to support, *not replace*, the radiologist's clinical judgment and to bring consistency to a very subjective area
- Volpara Scorecard: volumetric breast density scores can be integrated directly into Tyrer-Cuzick v8 for personalized risk assessment

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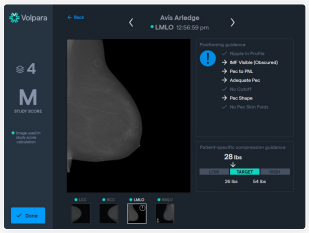
Training with objective quality assessment



- Volpara® Live™ software reports on every study taken with the aim of on-the-job training.

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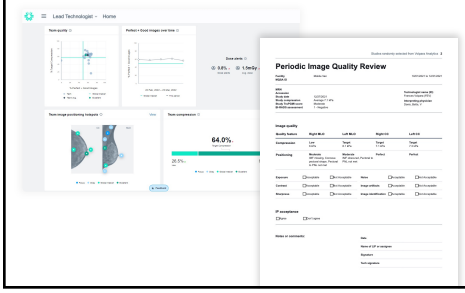
Enterprise-wide quality assurance



- Volpara® Analytics™ software provides objective, quantitative information to help ensure quality across the enterprise

Helps with audits:

- ACR
- FDA MQSA EQUIP

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AI use cases tomorrow: new areas of quantitative science

These are not Volpara products for sale today

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What is vPGMI?

- Efficient way of analyzing performance
- Comprehensive evaluation – *every exam, every time, automatically*
- Objective analysis - takes away personal bias
- Greater detail allows for more targeted training
- Individual RT's can track their own performance
- Streamlined and advanced method to measure performance and make quality improvement a standard operating procedure
- An alternative method of gathering data for the Radiological Technologist Audit and EQUIP

PERFECT - Mammogram is an example of excellent work

GOOD - Mammogram is high quality

MODERATE - Mammogram is acceptable quality; technologist would unlikely to repeat images(s)

INADEQUATE - Mammogram is poor quality; technologist might repeat images(s)

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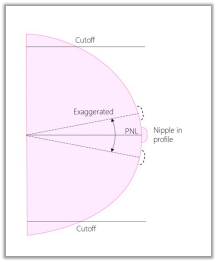
vPGMI and the CC View

Volpara uses the following methods to assesses breast geometry in the CC view:

- Nipple Central without Exaggeration
- No Cutoff
- Nipple in Profile
- PNL Length



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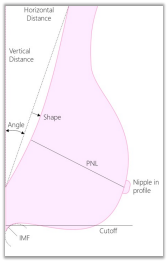
vPGMI and the MLO View

Volpara uses the following methods to assess breast geometry in the MLO view:

- Pectoral Muscle Length
- Pectoral Muscle Shape
- Nipple in Profile
- IMF Visible
  - Present and open
  - Present but obscured by a skin fold
  - Not in view



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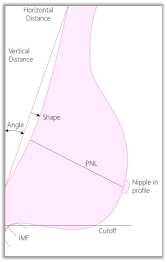
vPGMI and the MLO View

Volpara uses the following methods to assess breast geometry in the MLO view:

- PNL Length
- Comprehensive assessment of adequate pectoral including the extension and width of the muscle on the image
- Pectoral skin folds
- Detection of tissue cut-off



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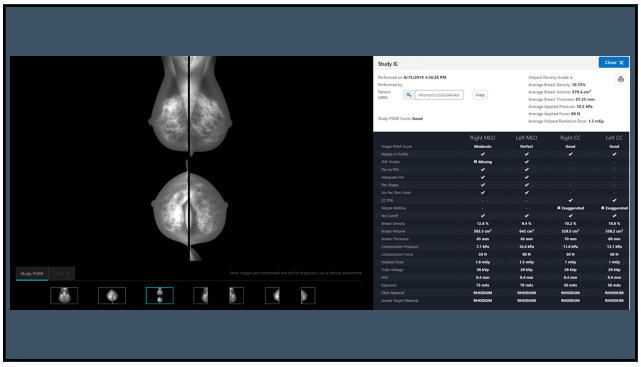
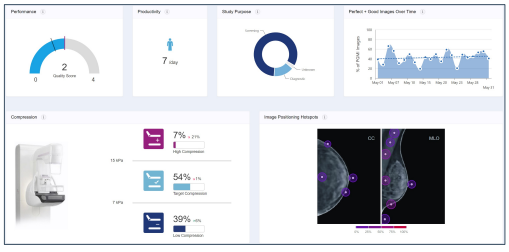


Every image, every time – Technologist Dashboard



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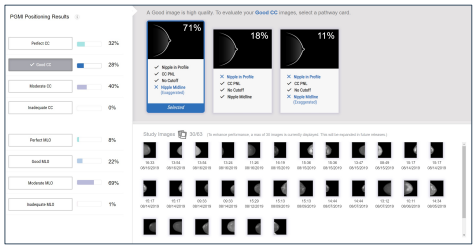
Every image, every time – Positioning Evaluation



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Every image, every time – Positioning Improvement

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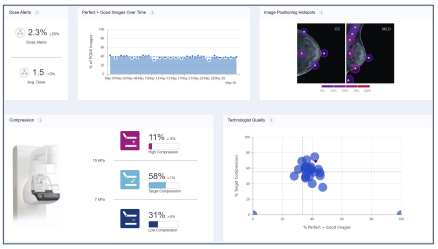
Every image, every time – Manager Review Dashboard



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Award performance for a job well done!

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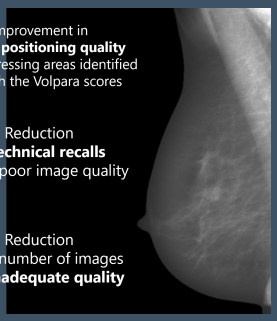
8% Improvement in **overall positioning quality** after addressing areas identified through the Volpara scores

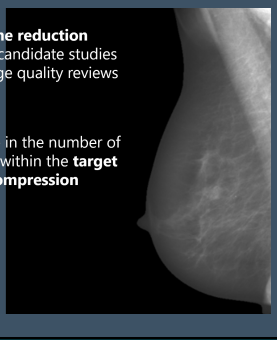
14% Reduction in **technical recalls** due to poor image quality

37% Reduction in the number of images with **inadequate quality**



60% **Time reduction** to find candidate studies for image quality reviews

20% Increase in the number of studies within the **target compression**



Thank you & Questions

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