Artificial Intelligence (AI) in Breast Imaging-Current and Future Opportunities

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Disclosures

- None

Objectives

- Define AI
- Breast Cancer screening overview
- Discuss some FDA approved AI applications for breast imaging
- Discuss potential applications for AI in breast imaging

Introduction

- Breast cancer-common cancer in women in the US
- Purpose of screening program-↓morbidity and mortality
- Screening mammography-modality with proven mortality benefit
- Widely used
- In US closely regulated: FDA/MQSA, EQUIP
- Opportunities for improvement in performance metrics

Background

- Using computers to improve performance is not new–CAD;
  - FDA approved in 1998, 2002 reimbursable by the CMS; rapid adoption 2008
  - Limited to no increase in diagnostic performance; ?increase recall rates
  - Failure of conventional CAD to improve and optimize mammography performance created continued opportunity for AI in breast imaging

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What is AI?

- Large field; technologies and applications with shared characteristics of using computer-based algorithms and data to solve problems or perform tasks that would typically require human intelligence
- In the past 10-20 years, tremendous advances in availability and accessibility of powerful computational hardware for processing and storing data needed for AI applications
- Increase in amount of availability of data for training AI algorithms

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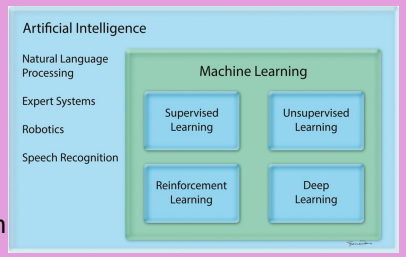
What is AI?

- Machine Learning (ML)
- Computers are trained and perform functions without explicit programming
- Uses features and input from human programmers as basis of learning



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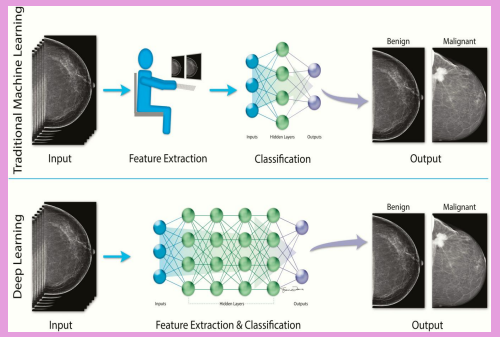
What is AI?

- Deep learning (DL)
- Features are extracted in hierarchical fashion and with many simple features making up more complex features
- Utilizing convolutional neural networks (CNN) improvements have been made in past 10-15 years for image analysis for non-medical images



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AI in breast imaging

Benefits:

+BIRADS lexicon

+Robust tracking

+Standard positioning

+Large available data sets

+Familiarity and acceptance of CAD

Challenges:

-Recent adoption of DBT

-Variability in appearance between vendors synthetic 2D images

-Files size

-Multi-modality tools

-Clinical information from many sources for accurate image interpretation

-Ethics, Privacy, Legality

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Applications of AI in Breast Imaging

Interpretive AI

Cancer detection

Decision support

Response to NAC

Non-interpretive AI

Cancer risk assessment

Density quantification

Workflow triage

Image quality assessment

Image enhancement

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AI for Cancer Detection

- Most focus on screening mammography
- Multiple FDA approved applications
- Best performance-AI algorithms combined with a radiologist
- Significant issues with understanding how AI applications perform in real world when used outside of trials
- Additional challenges with DBT (worse AI performance than FFDM)
- CESM-rapidly evolving modality→ opportunities for AI

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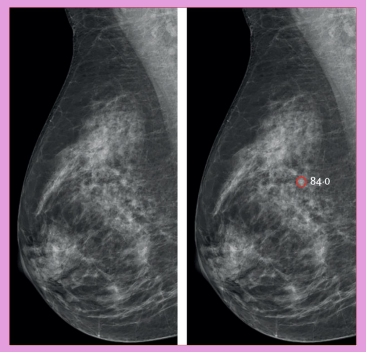
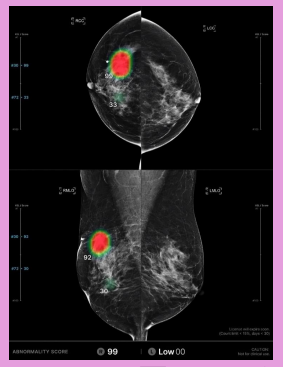
AI for Cancer Detection





Examples of different vendors AI tools to identify and stratify risk of malignancy.

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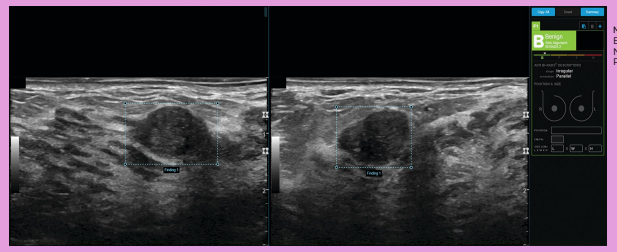
AI for Decision Support

- Improve radiologist's diagnostic performance
- Opportunities in decision support include:
  - ↓ benign biopsy recommendations
  - Minimizing false-negative interpretations
- Examples:
  - DBT Increased Sn; reducing false negative
  - predicting malignancy in calcifications
  - stratifying masses on ultrasound
  - breast MRI

AI for Decision Support-Breast Ultrasound

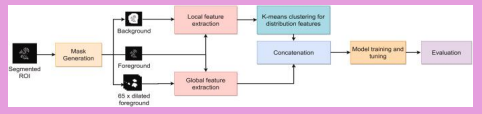


Manisha Bahl et al. Artificial Intelligence for Breast Ultrasound: *AJR* Expert Panel Narrative Review American Journal of Roentgenology; vol 223; Dec 2024

FDA approved tools for US are intended for soft-tissue lesion classification and/or detection
-->Improve specificity among nonspecialists and decrease interpretation time

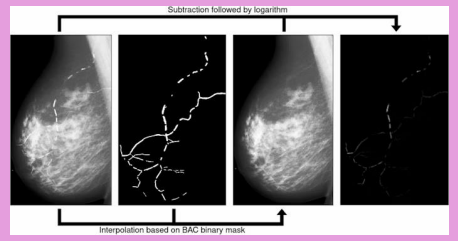
AI for Decision Support-Calcifications Stratification

- Quantitative analysis of the amorphous calcification morphology and distribution and their surroundings helps distinguish between benign versus malignant cases
- Unsupervised clustering identifies a consistent set of local shape and texture-based features
- Global features like variation in microcalcification size and spatial distribution predict high risk/malignant cases



AI for Decision Support-Vascular Calcifications Detection/Quantification

- Accurate, automated identification of BAC can improve cardiovascular risk stratification, especially in women whose disease may otherwise go unnoticed
- Recent advancements in AI and ML, particularly in DL models such as CNN, have shown tremendous promise in detecting and quantifying BAC with high accuracy
- Potential to transform mammographic screening into a dual-purpose tool for both breast cancer and cardiovascular risk assessment



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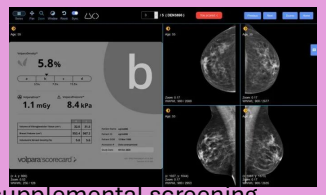
AI - Breast Density

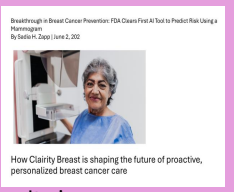


- Amount of fibroglandular tissue in the breast
- 40% of women in US have dense breasts
- Independent risk factor for breast cancer --> supplemental screening
- FDA requirement- breast density notification

- Variability in reporting interpersonal/intrapersonal
- Computer-based assessments in breast density reporting-high accuracy and agreement with rads

- Challenges-altered performance when moving from FFDM to synthetic images

AI - Cancer Risk Assessment


Breakthrough in Breast Cancer Prevention: FDA Clears First AI Tool to Predict Risk Using a Mammogram
By Sadie H. Zapp | June 2, 202

How Clairity Breast is shaping the future of proactive, personalized breast cancer care

- Identifying women at increased risk for breast cancer
- Current models estimate risk-such as Gail, Tyrer-Cuzick, etc

- New AI imaging-based risk models demonstrate promising results in cancer risk assessment; outperforming Tyrer-Cuzick
  - Mirai, a DL mammography-based risk model incorporates mammographic features and clinical factors to provide breast cancer risk prediction; has been validated in diverse international data set

  - Clairity Breast-analyze mammograms to predict a woman's future risk of breast cancer; first to receive FDA authorization for this purpose

- Making personalized AI image-based assessments is an opportunity for improved performance

AI - NAC Response

- NAC can reduce tumor size; allows in vivo evaluation of response; allowing therapeutic treatment plans to be modified
- MRI is currently best imaging method to determine response to NAC
- AI applied to imaging--predict tumor response to treatment prior to initiation of NAC
- Proof of concept study by Skarping et al demonstrated effectiveness of a DL based model using baseline digital mammogram to predict patient responses to NAC
- This may aid in clinical decision making prior to administering chemotherapy; potentially reducing patient morbidity

AI - Recurrence Prediction

- DL can assist in predicting and managing recurrence
- Its input can be clinical features, digital pathological images, and PET scans

- Studies show that combining AI, clinical data, and imaging can improve BC recurrence prediction and guide treatment decisions

AI - Image Enhancement

- Novel investigation and development to enhance images
- AI based applications -highlight calcifications, distortion, and round masses
- Example AI based process to collapse and merge suspicious regions of interest from DBT into “maximum suspicious projections” to emphasize the suspicious features
- Additional AI applications look to reduce amount of contrast dose needed for breast MRI

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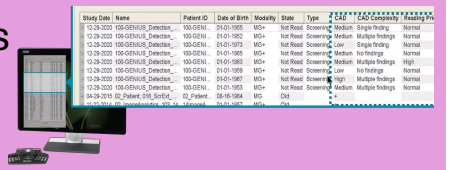
AI Workflow Applications



- Improve workflow for rads
  - Improved efficiency-DBT-reducing number of slices (3DQuorum™ Imaging Technology, for accelerated reading)
- Prioritize patients; most well-studied with screening mammograms
  - AI based triage algorithm: retrospective study-normal-no rad; moderate risk-rads review; suspicious-recalled; non inferior sensitivity to rads review; workload reduction by 62%
  - Replace second reader with AI; or offer second reader as AI

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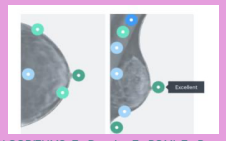
AI Quality Assessment

- Importance of maintaining high quality positioning and technique
- MQSA (poor positioning-leading cause of deficiencies and misdiagnosis)
- FDA EQUIP- focuses on ensuring and improving quality
- AI algorithms evaluate the image and provide feedback and opportunity for improvement to technologists and physicians



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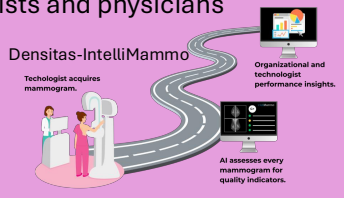

• VOLPARA ALGORITHMS- TruDensity; TruPGMI; TruPressure; TruRadDose

AI - Future Directions

- There are multiple available FDA approved AI based applications for breast imaging
- There are many areas currently investigated
- Potential areas of AI applications are in various degrees of maturity and availability

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Barriers to AI implementation

- Inconsistent performance
- Significant cost
- IT requirements
- Lack of familiarity by rads/technologists/patients/referring clinicians=lack of trust
- Lack of re-imbursement
- Lack of understanding how best to interact with AI (example inexperienced radiologist over rely on AI)
- Lack of governenance
- Risk of patient privacy
- Liability concerns

- Real need for careful evaluation of applications for each site and close monitoring of performance

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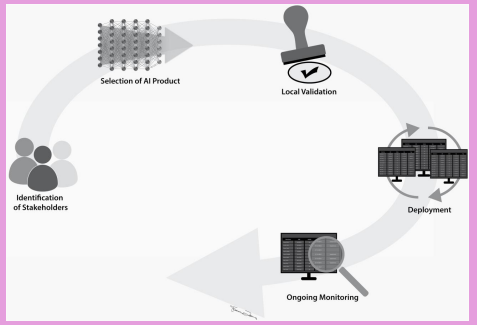
Steps involved in clinical implementation of an AI product



J Breast Imaging, Volume 4, Issue 6, November/December 2022, Pages 632–639, https://doi.org/10.1093/jbi/wbac065

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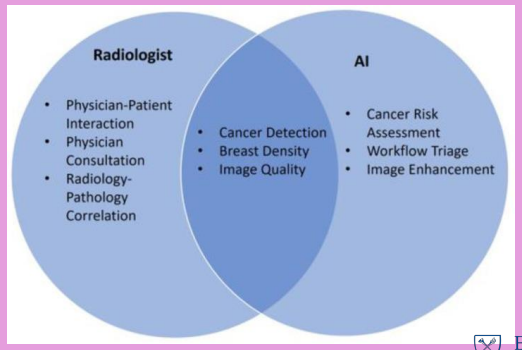
Roles Defined for Radiologist and AI in Clinical Care



Diagnostics (Basel). 2023 Jun 13;13(12):2041. doi: 10.3390/diagnostics13122041

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References

Skarping, I., Larsson, M. & Förnvik, D. Analysis of mammograms using artificial intelligence to predict response to neoadjuvant chemotherapy in breast cancer patients: proof of concept. *Eur Radiol* **32**, 3131–3141 (2022). https://doi.org/10.1007/s00330-021-08306-w

M. Bahl. Artifical Ineligence: A primer for Breast Radiologists. *J Breast Imaging*, Volume 2, Issue 4, July/August 2020, Pages 304–314, https://doi.org/10.1093/jbi/wbaa033

Manisha Bahl, Jung Min Chang, Lisa A. Mullen, and Wendie A. Berg Artificial Intelligence for Breast Ultrasound: *AJR* Expert Panel Narrative Review American Journal of Roentgenology 2024 223:6

Taylor, CR, Monga, N, Johnson C, Hawley J, Patel M. Artificial Intelligence Applications in Breast Imaging: Current Status and Future Directions. Diagnostics (Basel) 2023 Jun 13;13(12):2041. doi: 10.3390/diagnostics13122041

Gabriel Chartrand, Phillip M. Cheng, Eugene Vorontsov, Michal Drozdzal, Simon Turcotte, Christopher J. Pal, Samuel Kadoury, and An Tang. Deep Learning: A Primer for Radiologists RadioGraphics 2017 37:7, 2113-2131

Yala A, Lehman C, Schuster T, Portnoi T, Barzilay R. A Deep Learning Mammography-basedMOdel for Improved Breast Cancer Risk Prediction. Radiology 2019, 292, 60-66

Optimized Program Performance-Volpara Health. Available online

M. Bahl. Artificial Intelligence in Clinical Practice: Implementation Considerations and Barriers. JBI. 2022, 4, 632-639.

Automated quantitative assessment of amorphous calcifications: Towards improved malignancy risk stratification Kalyani Marathe a , Chrysostomos Marasinou b , Beibin Li c , Noor Nakhaei b , Bo Li d , Joann G. Elmore e , Linda Shapiro a,c , William Hsu b,* Computers in Biology and Medicine Volume 146, July 2022, 105504

W Li, Q Zhang, D Black, Hu Ding, Ca Iribarren, A Shojazadeh, S Molloi. Quantification of Breast Arterial Calcification in Mammograms Using a UNet-Based Deep Learning for Detecting Cardiovascular Disease, Academic Radiology, Volume 32, Issue 9, 2025, pages 5028 -5038, ISSN 1076-6332, https://doi.org/10.1016/j.acra.2025.05.036.

Conclusion

- Tremendous opportunity to improve quality of breast imaging
- Most significant challenges are validating AI performance and overcoming implementation challenges

THANK YOU!

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