RSNA Press Release

AI Could Provide ‘Early Alert’ for Breast Cancer 6 Years in Advance

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Fredrik Strand, M.D., Ph.D.

OAK BROOK, Ill. — Three commercially available radiology AI systems have shown the potential to flag early signs of breast cancer up to 6 years before a diagnosis, according to a study published in *Radiology*, the flagship journal of the Radiological Society of North America (RSNA).

In a Swedish retrospective study, researchers tested three AI-based computer-assisted detection (AI-CAD) systems on mammogram data from a large screening population. They found that cancer prediction scores issued by AI-CAD were elevated, on average, for individuals who were eventually diagnosed with breast cancer, while scores were low for those who remained cancer-free.

“Approximately 20% of breast cancer cases demonstrate mammographic signs that are already visible to AI around 6 years before diagnosis,” explained senior coauthor Fredrik Strand, M.D., Ph.D., of Karolinska University Hospital in Stockholm. “Our study confirms the potential of AI to, in some cases, find signs of cancer in the mammograms much earlier than when radiologists detected it.”

AI-based systems have shown promise for predicting 5-year risk of breast cancer and identifying women at risk of “interval” cancers between regular screening mammograms. Dr. Strand’s team investigated AI’s potential to flag mammographic signs that were present up to 10 years in retrospect.

For the study, the researchers included a total of 88,963 mammograms performed on 31,394 patients across a period of 10 years. Data were taken from the Validation of Artificial Intelligence for Breast Imaging (VAI-B) database, which collects breast imaging data from volunteers across four regions of Sweden. The Swedish national breast screening program invites women between the ages of 40 and 74 to participate in screening examinations every 2 years, and each mammogram has traditionally been read by two radiologists.

Dr. Strand’s team applied three commercially available AI-CAD systems to mammograms taken between January 2008 and April 2019. Across that period, 12,072 of the participants, or 38.5%, were diagnosed with cancer by radiologist readers.

The AI-CAD systems successfully identified many of those cancers at earlier screening points, achieving 90% specificity—distinguishing between a true positive and a true negative result—in up to 19.7% of individuals 6 years before their recorded diagnosis, up to 25.2% of individuals 4 years before diagnosis and up to 39.3% 2 years before diagnosis.

AI-CAD scores could help radiologists spot early mammographic signs of potential future cancers, and a personalized approach to interpreting individual scores could help identify patients who might benefit from closer vigilance.

“This study aims to add to the growing literature regarding the application of AI in breast cancer screening and how

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it can help play a role in earlier detection of breast cancer," said Dr. Strand. "Analyzing the AI scores of screened individuals over time could provide insight into how early detectable changes arise, potentially allowing for earlier intervention."

"Artificial Intelligence Detection Scores in Screening Mammography for Early Breast Cancer Alerts." Collaborating with Dr. Strand were Sarah Hickman, M.D., Ph.D., Pantelis Gialias, M.D., Haiko Schurz, Ph.D., Fernando Cossio, B.Sc., Taeyang Choi, M.Sc., Apostolia Tsirikoglou, Ph.D., Håkan Gustafsson, Ph.D., and Sophia Zackrisson, M.D., Ph.D.

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For patient-friendly information on mammography, visit *RadiologyInfo.org*.

Images (JPG, TIF):

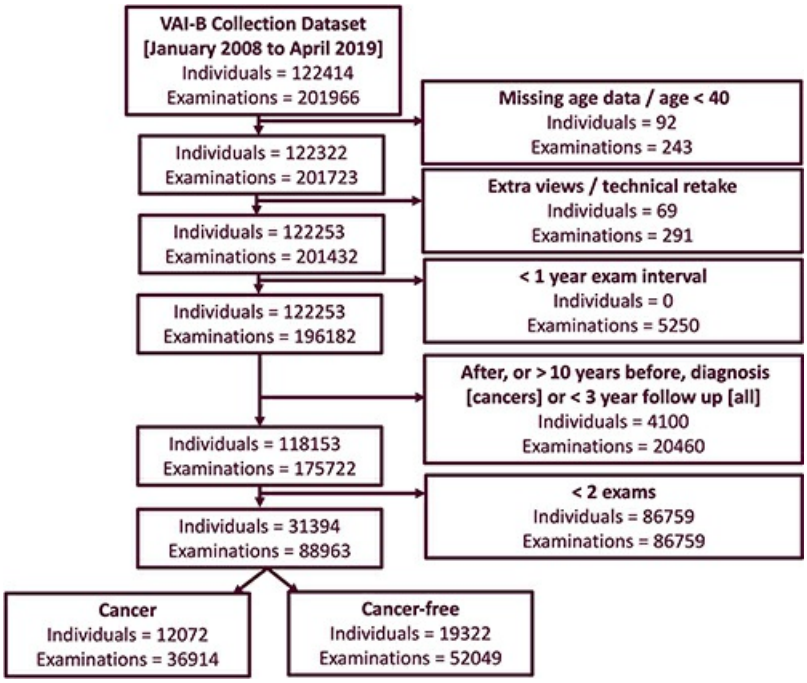

Figure 1. Standards for Reporting of Diagnostic Accuracy Studies (STARD) flow diagram of individuals and mammographic examinations included in this study. VAI-B = Validation of Artificial Intelligence for Breast Imaging.

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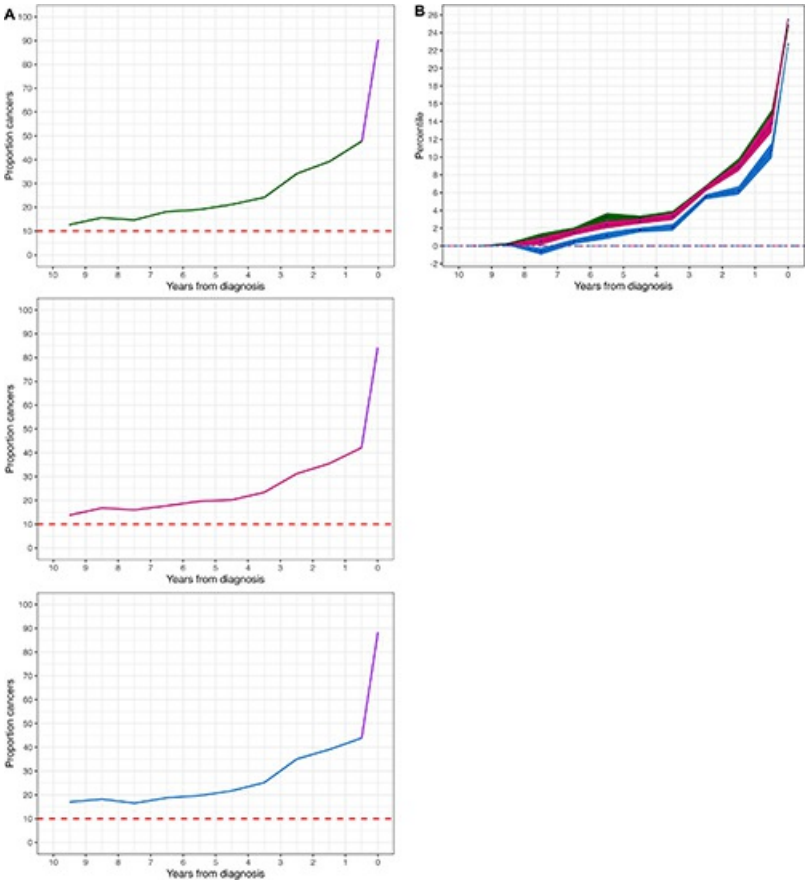

Figure 2. (A) Graphs of the proportion of examinations in individuals with future breast cancer that had an artificial intelligence (AI) score above the 90th centile over the 10 years before diagnosis. The AI scores were from three AI-based computer-aided detection systems: AI-1 (top, green), AI-2 (middle, pink), and AI-3 (bottom, blue). The purple line segment in each graph represents screen-detected cancer diagnosis time point 0 (screen-detected cancers were defined as those diagnosed within 90 days for individuals who were recalled during screening). **(B)** Graph of mean change in AI score between screenings for each AI-based CAD system (AI-1, green; AI-2, pink; AI-3, blue; shading = standard error) for individuals diagnosed with cancer and cancer-free individuals (multicolored line near 0). All case AI scores were converted to percentiles for the analysis. In **B**, to aid visualization, the change in percentiles over time was multiplied by 100.

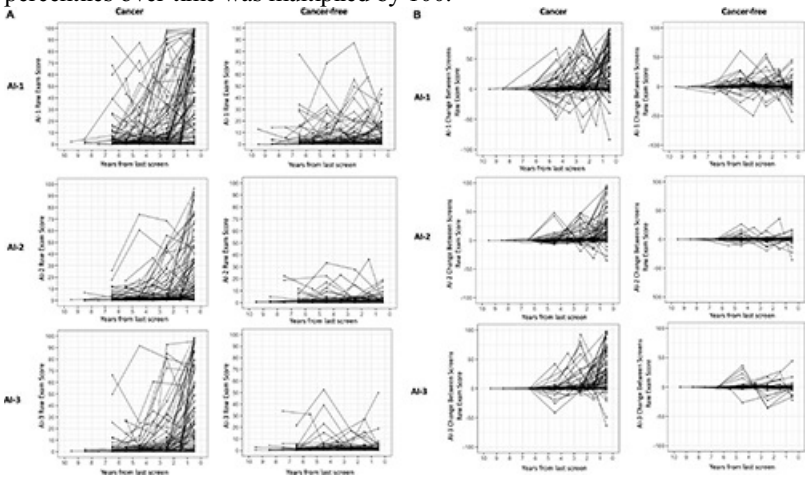

Figure 3. Spaghetti plots of individual changes in artificial intelligence (AI) scores from three AI-based computer-aided detection systems (AI-1, AI-2, and AI-3) for 100 random individuals with breast cancer (left) and 100 cancer-free individuals (right) with four examination time points available, plotted by years before their last screening examination. The graphs demonstrate variability in AI scores for individuals over multiple screening time points. **(A)** Raw examination AI scores, adjusted to a 0–100 scale, for each time point. **(B)** Absolute difference (positive or negative) in examination AI scores between successive time points. Screen-detected cancer time point 0 data are included in the graphs.

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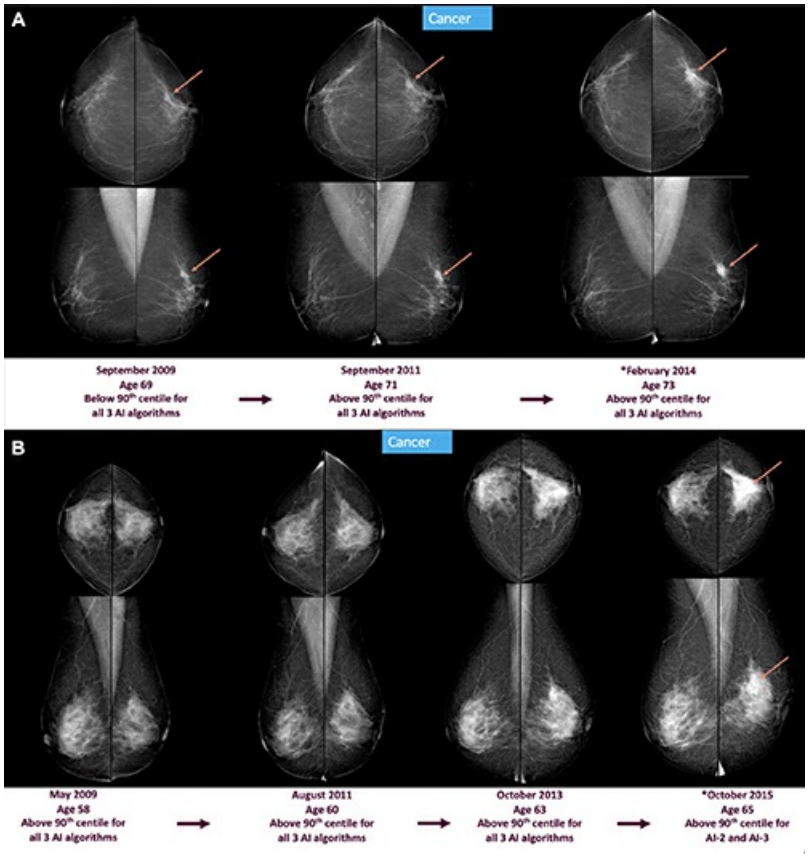

Figure 4. Screening mammograms and artificial intelligence (AI) score changes over time in two individuals with screen-detected cancer. Full-field digital mammograms show craniocaudal (top) and mediolateral (bottom) views of the left and right breast. The description below each mammogram indicates whether AI scores from three AI-based computer-aided detection systems (AI-1, AI-2, and AI-3) were above or below the 90th percentile. **(A)** Mammograms from three screening time points (in 2009, 2011, and 2014) in an individual who was diagnosed in February 2014 (at age 73 years) with a left-sided 25-mm grade 2 invasive breast carcinoma, no special type (arrow). Mammographic breast density was classified as Breast Imaging Reporting and Data System B on all three mammograms. **(B)** Mammograms from four screening time points (in 2009, 2011, 2013, and 2015) in an individual who was diagnosed in October 2015 (at age 65 years) with a left-sided 45-mm grade 2 lobular carcinoma (arrow). Mammographic breast density was classified as Breast Imaging Reporting and Data System C on all four mammograms. Screen-detected cancers were defined as those diagnosed within 90 days for individuals who were recalled at screening.

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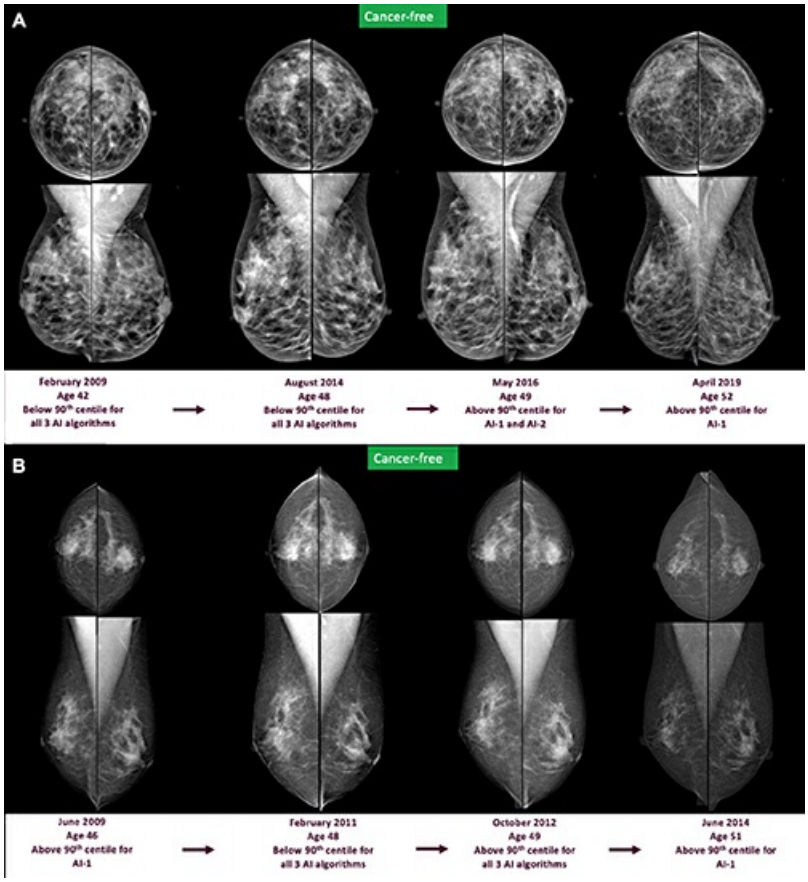

Figure 5. Screening mammograms and artificial intelligence (AI) score changes over time in two individuals who remained cancer-free. Full-field digital mammograms show craniocaudal (top) and mediolateral (bottom) views of the left and right breast. The description below each mammogram indicates whether AI scores from three AI-based computer-aided detection systems (AI-1, AI-2, and AI-3) were above or below the 90th percentile. **(A)** Mammograms from four screening time points (in 2009, 2014, 2016, and 2019) in an individual first screened at age 42 years. **(B)** Mammograms from four screening time points (in 2009, 2011, 2012, and 2014) in an individual first screened at age 46 years.

Resources:

Abstract link

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