RSNA Press Release

Researchers Use Deep Learning to Predict Breast Cancer Risk

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OAK BROOK, Ill. — Compared with commonly used clinical risk factors, a sophisticated type of artificial intelligence (AI) called deep learning does a better job distinguishing between the mammograms of women who will later develop breast cancer and those who will not, according to a new study in the journal Radiology. Researchers said the findings underscore AI’s potential as a second reader for radiologists that can reduce unnecessary imaging and associated costs.

At A Glance

- Researchers trained a deep learning model to find details in mammograms that might be linked to increased cancer risk.
- The model outperformed clinical risk factors—including breast density—in determining screening-detected cancer risk.
- The findings support a role for AI in combination with clinical risk factors in breast cancer risk assessment.

Annual mammography is recommended for women starting at age 40 to screen for breast cancer. Research has shown that screening mammography lowers breast cancer mortality by reducing the incidence of advanced cancer.

Mammograms not only help detect cancer but also provide a measure of breast cancer risk through measurements of breast density. While denser breasts on mammography are associated with a higher risk of cancer, there are other, yet unknown, factors hidden in the mammogram that likely contribute to risk.

John A. Shepherd, Ph.D.

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“Conventional methods of breast cancer risk assessment using clinical risk factors haven’t
been that effective,” said study lead author John A. Shepherd, Ph.D., professor and
researcher in the Population Sciences in the Pacific Program (Epidemiology) at the
University of Hawaii Cancer Center in Honolulu. “We thought that there was more in the
image than just breast density that would be useful for assessing risk.”

For the new study, Dr. Shepherd and colleagues used a data set of more than 25,000 digital
screening mammograms from 6,369 women who participated in screening mammography.
More than 1,600 of the women developed screening-detected breast cancer, and 351
developed interval invasive breast cancer.

The researchers trained the deep learning model to find details, or signals, in the
mammogram that might be linked to increased cancer risk. When they tested the deep
learning-based model, it underperformed in assessing the risk factors for interval cancer
risk, but it outperformed clinical risk factors including breast density in determining
screening-detected cancer risk.

“The results showed that the extra signal we’re getting with AI provides a better risk
estimate for screening-detected cancer,” Dr. Shepherd said. “It helped us accomplish our
goal of classifying women into low risk or high risk of screening-detected breast cancer.”

The findings have significant implications for clinical practices in which breast density
alone guides many management decisions. Instead of being advised to return next year for
another screening, women with a negative mammogram could be sorted by risk into one of
three pathways: low risk of breast cancer, elevated screening-detected risk, or elevated
interval invasive cancer in the next three years, the average follow-up time for the study.

“This would allow us to use a woman’s individual risk to determine how frequently she
should be monitored,” Dr. Shepherd said. “Lower-risk women might not need to be
monitored with mammography as often as those with a high risk of breast cancer.”

The deep learning model also has promise in supporting decisions about additional imaging
with MRI and other modalities. Dr. Shepherd said that women in the high-risk deep learning
group who also have dense breasts and are at a higher risk for interval cancers may benefit
most from a monitoring strategy that includes supplemental imaging that retains sensitivity
in dense breasts such as MRI, ultrasound and molecular imaging. Interval cancers usually
have more aggressive tumor biology and are typically discovered at an advanced stage.

Along with other recent research, the new study supports a role for AI in combination with
clinical risk factors in breast cancer risk assessment.

“By ranking mammograms in terms of the probability of seeing cancer in the image, AI is
going to be a powerful second reading tool to help categorize mammograms,” Dr. Shepherd
said.

The researchers are planning to replicate the study in Native Hawaiian and Pacific Islander
women, two groups that have been underrepresented in breast cancer research. They also
want to extend the work beyond cancer risk to look at the risk of different grades of breast
cancer, from least to most aggressive.

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“Deep Learning Predicts Interval and Screening-detected Cancer from Screening Mammograms: A Case-Case-Control Study in 6369 Women.” Collaborating with Dr. Shepherd were Xun Zhu, Ph.D., Thomas K. Wolfgruber, Ph.D., Lambert Leong, M.S., Matthew Jensen, B.S., Christopher Scott, M.S., Stacey Winham, Ph.D., Peter Sadowski, Ph.D., Celine Vachon, Ph.D., and Karla Kerlikowske, M.D.

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