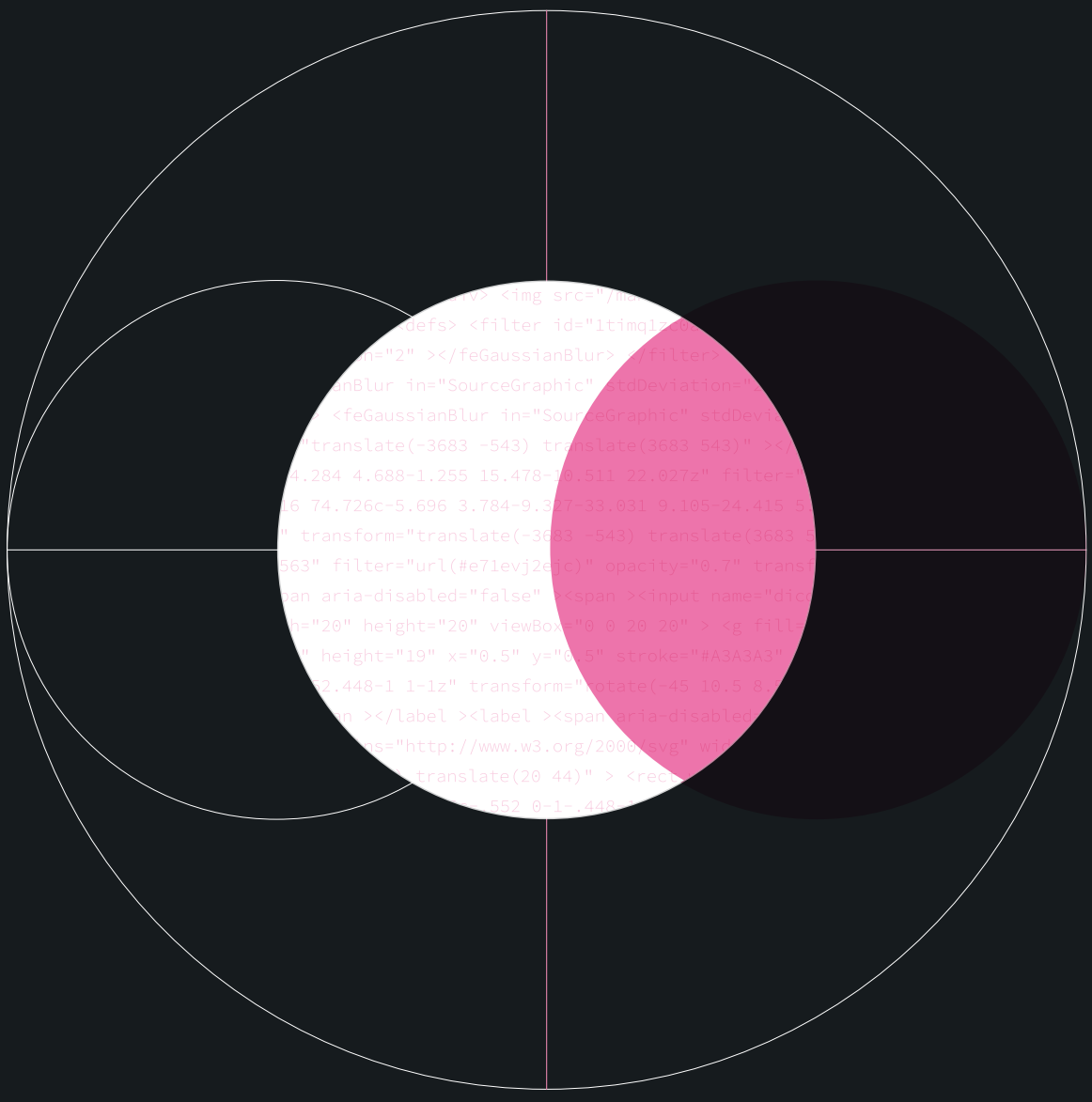
Lunit INSIGHT MMG

AI Solution for Mammography



Lunit

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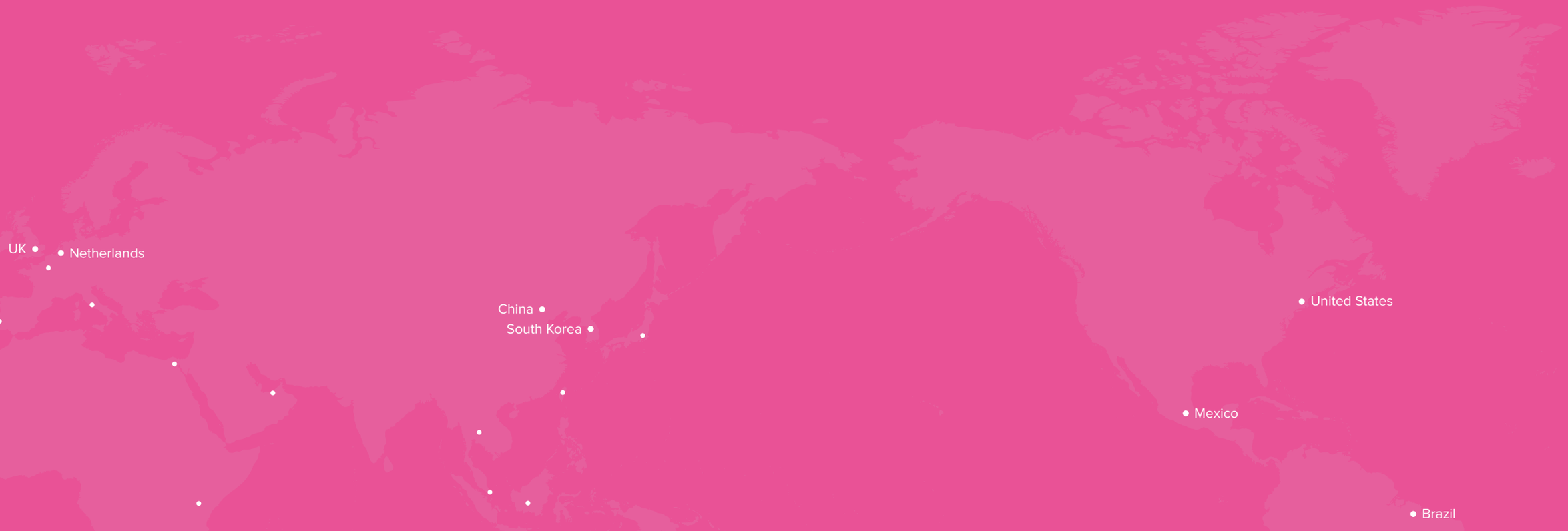
Lunit INSIGHT MMG

Product Information

User Testimonials



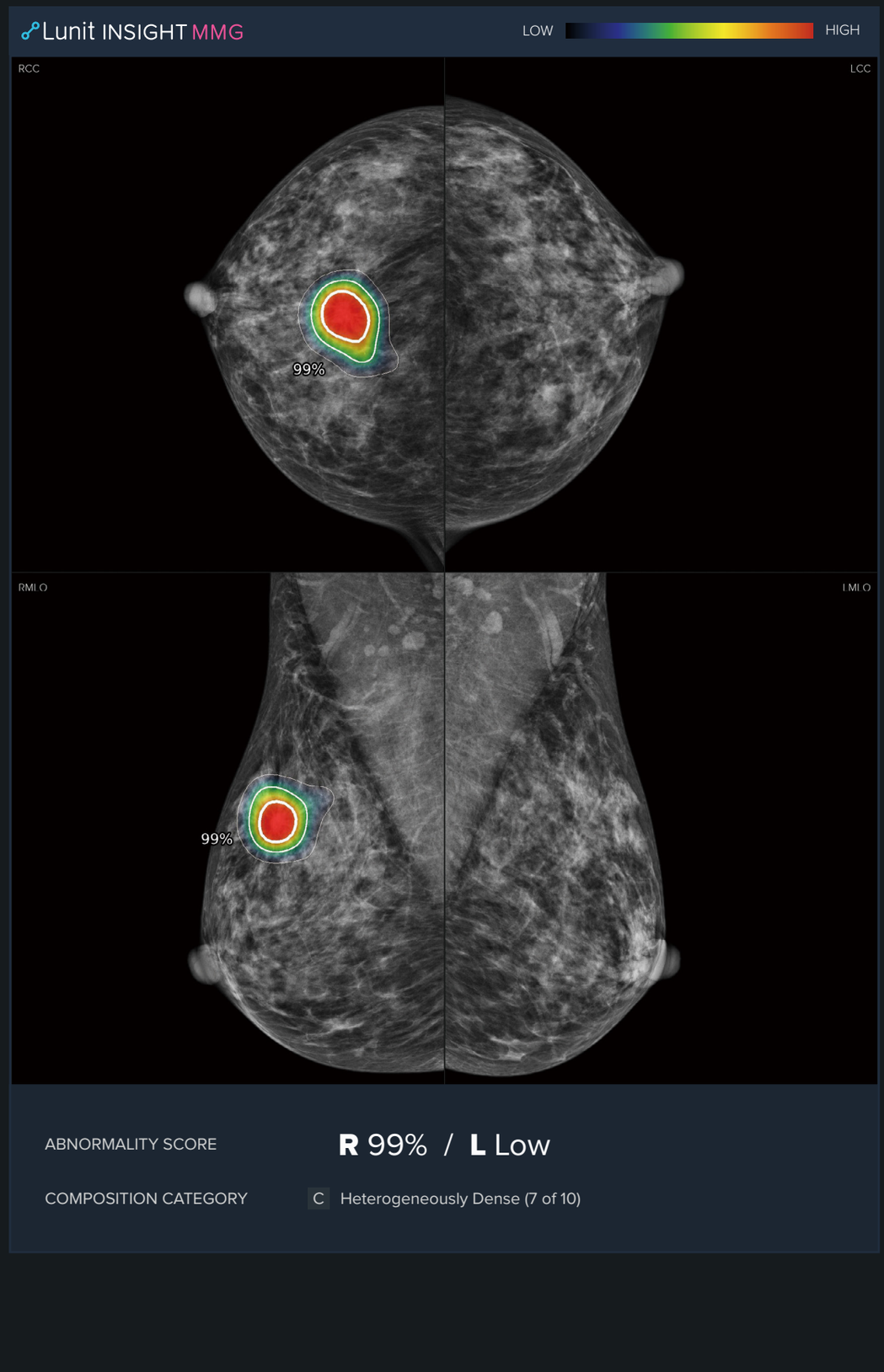
200+
Reference Sites

80+
Countries Worldwide

7M+
Images Analyzed
(for clinical and research use)

Breast cancer is no longer tricky to find.

with AI.



What does Lunit INSIGHT MMG analyze on mammograms?

Lunit INSIGHT MMG detects breast cancer on mammograms with 96% accuracy.

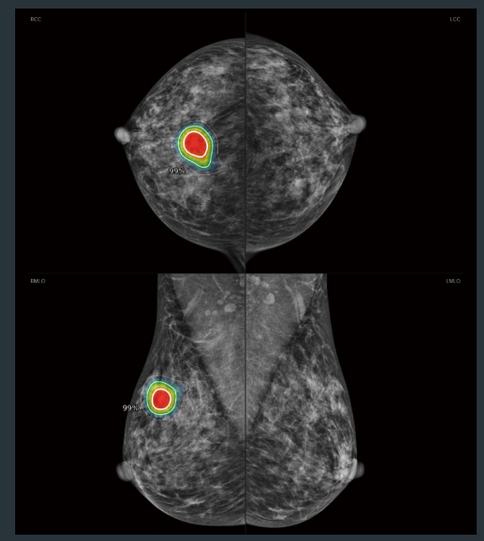
96%

Detects breast cancer with 96% accuracy

Lunit INSIGHT MMG generates

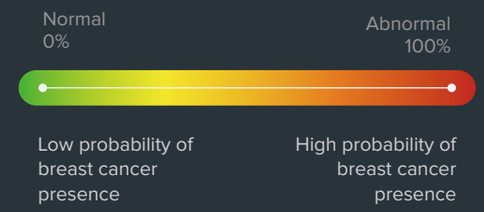
Detected Location

The location information of detected breast cancer in the form of heatmap and outlines



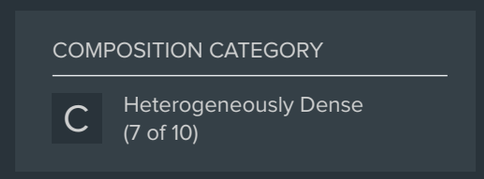
Abnormality Score

An abnormality score for each side of the breast, which reflects the AI's calculation of the actual presence of the detected breast cancer



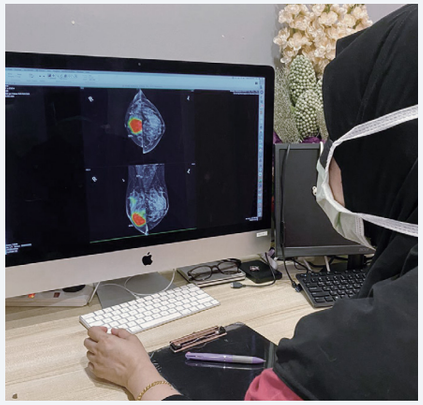
Density Assessment

Assessment of breast density, categorized into four types



Breast Surgeons Use AI in Reading Mammograms Pre-/Post-Surgeries

FeM Surgery, Singapore



“Lunit INSIGHT MMG helps to highlight problem areas on a mammogram, encouraging me to double-check in order to avoid overlooking subtle lesions. It is like working with a second-reader whom I can rely on.

Dr. Felicia Tan

FeM Surgery's Breast Centre is a breast surgical practice center with more than 500 breast procedures and 200 breast cancer surgeries conducted per year.

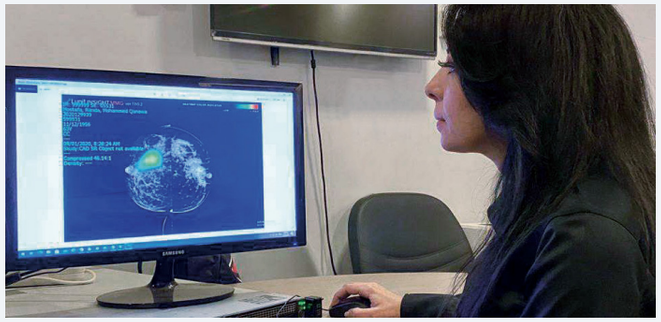
When patients visit the center, they normally undergo mammography as the primary screening exam. However, due to the long turnaround time of formal radiology reports, the surgeons previously had to wait up to two days to receive the radiology reports and proceed with the next round of exams and follow-up procedures.

Dr. Felicia Tan said, “As our center is an outpatient facility, it is important that we provide diagnosis results and come up with treatment plans while patients are visiting. In order to reduce unnecessary recalls and delay in the treatment process for breast cancer, we decided to adopt Lunit AI solution, hoping it would help our surgeons read mammograms on the spot and as accurately as the radiologists.”

“Lunit AI algorithm detects very subtle lesions I could overlook such as subcentimetre ductal carcinoma in situ or vague architectural distortion. It is like working with a second-reader whom I can rely on. It confirms my interpretation and encourages me to double-check possible problem spots. In addition, the analysis result is very intuitive and easy to understand, and it significantly speeds up my reading process for each mammogram.”

AI scans mammograms as the first reader, helping us where to look

Qasr ElAiny Hospital-Cairo University, Egypt



> **“With AI providing the preliminary analysis result with information about where to look on each mammogram, we are now able to leverage our time and efforts more efficiently.**
>
> **Dr. Sahar Mansour**

The women's imaging unit in the department of radiology at the Kasr ElAiny Hospital Cairo University consults about 35 patients a day.

Previously, mammograms were interpreted by two readers. The first reader provided primary diagnosis; the second reader confirmed the suggested diagnosis. For debatable cases such as BI-RADS category 3 and 4, the third reader settled on the final diagnosis and ordered a follow-up test or a proper procedure.

Since July 2019, however, Lunit INSIGHT MMG has been playing the role of the first reader, sorting out mammograms. Positive cases with the location and score of detected lesions are assigned to the second reader, and negative cases to the third reader to confirm.

Prof. Sahar Mansour said, “This new reading workflow with AI has remarkably streamlined the reading efficiency and has saved us lots of time. Previously, we got six radiologists involved in reading every case. However, with AI providing the preliminary analysis result with information about where to look on each mammogram, we are now able to leverage our time and efforts more efficiently.”

“What’s also great about using Lunit AI solution is the improved interpretation for dense breasts, which is quite common in Egypt. Lunit AI algorithm accurately detects breast cancer lesions overlapping glandular tissues and subtle lesions that are not quite obvious to the naked eye. It has certainly helped us diagnose more breast cancers in dense breasts.”

What are the major benefits of using it?

Detect more
breast cancers.

Fast triage
of normal cases.

Improved reading performance of general radiologists.

01

Detect more breast cancers

The combination of first-reader radiologists and Lunit AI detects more breast cancers, than not only the first-reader and second-reader radiologists but also the double reading by radiologists.[1]

Health check-up centers
Community hospitals and clinics
Radiology departments

02

Fast triage of normal cases

According to the abnormality scores generated by AI, radiologists can successfully triage up to 60% of the entire cases without human interpretation, which can reduce their workload by more than half in mammogram interpretation.[2]

Health check-up centers
Imaging clinics
Teleradiology centers

60%
Triage 60% of the entire cases without human interpretation

03

Improved reading performance of general radiologists

General radiologists can use the AI analysis results to improve their reading performance, at a level up to that of breast specialists.[3]

Health check-up centers
Community hospitals and clinics
Radiology departments

Early diagnosis of breast cancer.

Support for decision-making on BI-RADS 3 and 4 cases.

Improved diagnostic accuracy for dense breasts.

04

Early diagnosis of breast cancer

Radiologists can detect T1 and node-negative breast cancer with 91% and 87% accuracy, respectively.[4]

Health check-up centers
Community hospitals and clinics
Radiology departments

91% *AI detection accuracy of T1 breast cancer*

87% *AI detection accuracy of node-negative cancer*

05

Support for decision-making on BI-RADS 3 and 4 cases

For difficult cases classified as BI-RADS 3 or 4, radiologists can compare their reading result and decide with confidence for additional exams such as ultrasound and biopsy.

Health check-up centers
Community hospitals and clinics
Radiology departments

06

Improved diagnostic accuracy for dense breasts

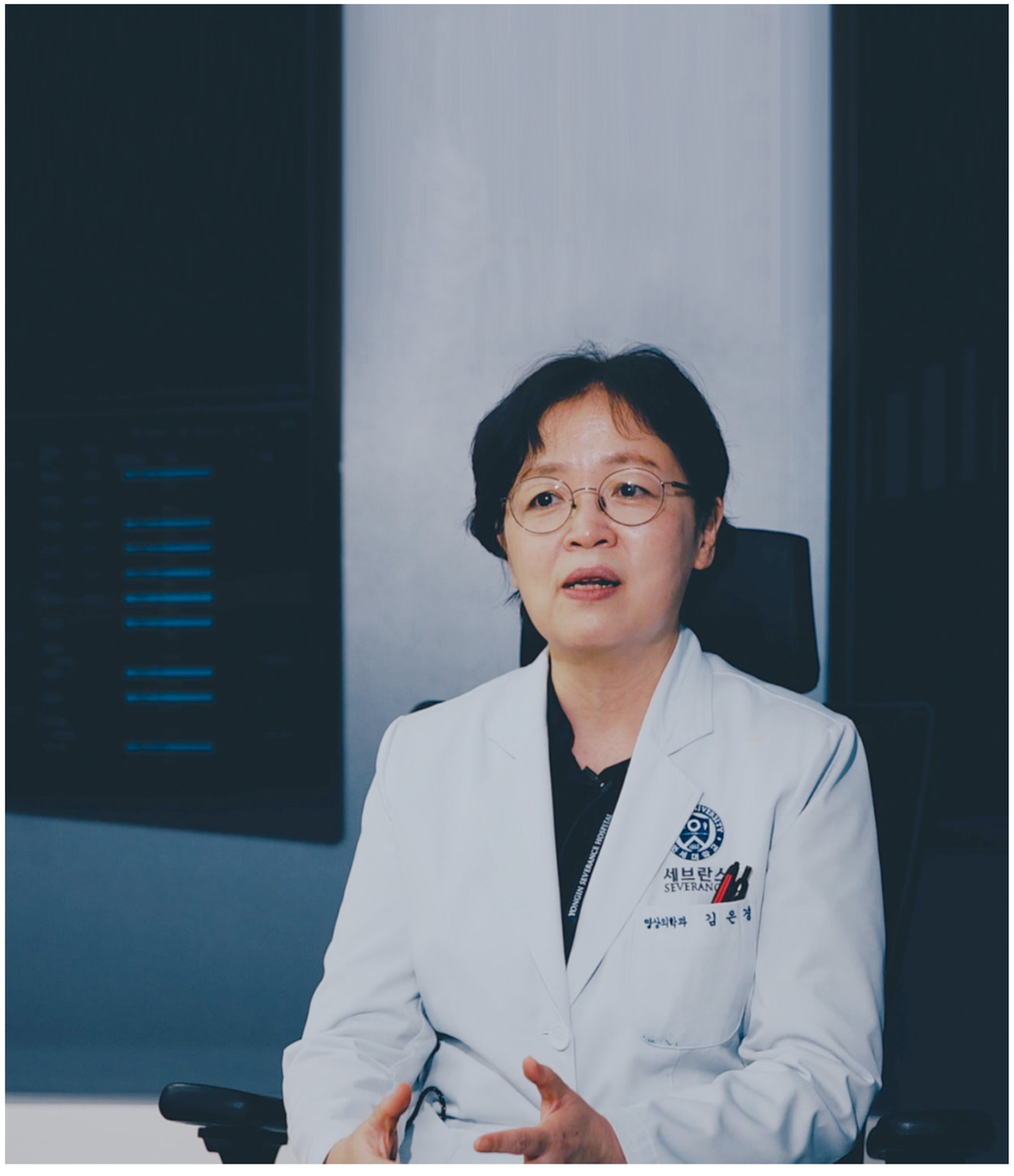
Radiologists can improve their diagnostic accuracy for dense and fatty breasts by up to 9% and 22%, respectively.[5]

Health check-up centers
Community hospitals and clinics
Radiology departments

9% *Dense breast cancer diagnosis increased by 9% with AI.*

22% *Dense breast cancer diagnosis increased by 22% with AI.*

User Interview



Dr. Eun-kyung Kim

Medical Doctor at Yonsei University
College of Medicine Yongin Severance Hospital in Korea

Click to Watch

Q1. While helping to develop Lunit's AI as a co-developer, what did you emphasize as being important?

We have used many CAD systems before, but most of them showed high sensitivity and low specificity. However, in order to be used in clinical practice, both the sensitivity and specificity should be high. Besides, reading speed is also just as important. It's like killing three birds with one stone. None of them should be left out. However, it was hard to find a CAD system that satisfied all three requirements. So for the last five years I had been working with Lunit to develop an AI solution, I kept emphasizing that we should meet all three requirements. The system should be able to detect breast cancer accurately, filter out benign cases and improve the overall reading efficiency. I'm using the AI solution in my daily practice now and I'm very happy to see that it shows high performance in all three aspects.

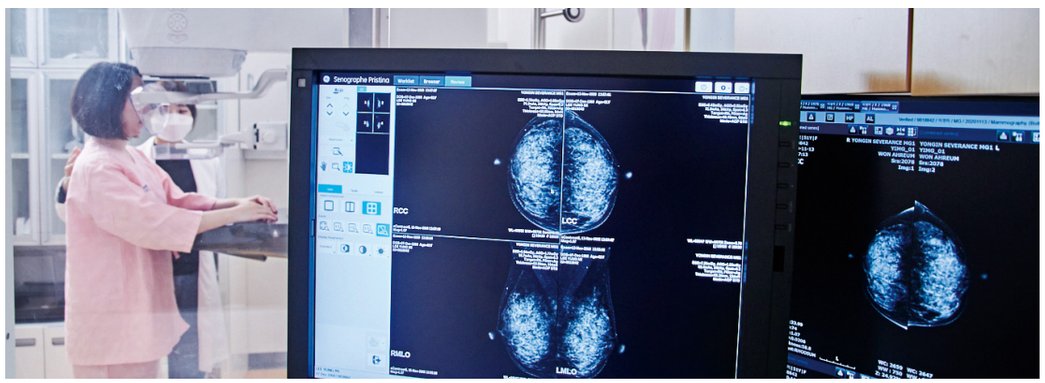
Q2. How has AI reduced the time it takes for reading?

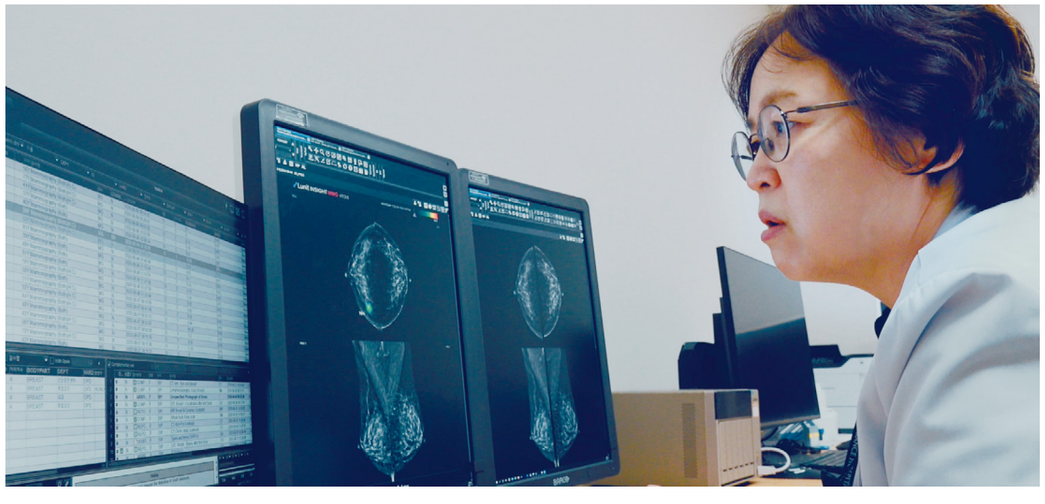
I would say that my reading time has been reduced by up to 30%. You might be concerned that AI is now going to take over your tasks and even your role as a radiologist. But that is not likely going to happen. Think of the navigation of your car. Using the navigation, you get to the destination even faster.
AI plays quite a similar role to the navigation. It's like you have a smart radiologist by your side assisting you. Using AI, you will be able to significantly improve your reading efficiency. In my case, I try to reallocate my time towards meeting patients and conducting other exams including biopsy, MRI, and CT, where I can use my expertise to the fullest. In conclusion, Lunit AI allows me to reallocate my time for other tasks, ultimately improving my overall reading efficiency.

Q3. How does AI help improve your reading accuracy?

I have conducted a reader study with experienced radiologists, and less experienced radiologists. With AI, experienced radiologists rarely improved their reading performance, as they were already high enough. On the other hand, less experienced radiologists significantly improved their reading performance up to a level similar to that of experienced radiologists. It was one of the key takeaways from the study. In particular, breast cancer is hard to detect on mammograms, which makes it even harder for less experienced radiologists. If AI helps to improve their reading performance up to that of experienced radiologists, then the average performance of every radiologist goes up. As for the performance of AI itself, it certainly outperforms entry-level breast specialists. However, the division is not AI versus radiologists; it's radiologists with AI versus radiologists without.
I believe AI is going to increase the average performance of all radiologists.
The diagnostic performance of major cancers varies by hospital, which is considered a critical issue in Korea.
I believe Lunit AI can contribute to addressing this issue, by helping radiologists who aren't specialized in breast imaging to improve their reading performance. This finding has been found not only in my study but also in other studies from abroad.

> **AI plays quite a similar role to navigation. It's like you have a smart radiologist by your side assisting you.**





Q4. How are you using the abnormality score feature?

We have been using Lunit AI to read chest x-ray exams and mammograms. Those exams are normally conducted for screening purposes. If you read 100 cases, 90 cases are normal, and only 10 are abnormal. To read more efficiently, what I do first thing in the morning is to examine the abnormality scores. And then I start reading cases with high abnormality scores with my full attention and concentration. When reading the cases, I sometimes browse through books and discuss with my co-workers. When I'm done with them, I start reading normal cases, mostly in the late afternoon. Being able to prioritize images according to their abnormality score enables me to use my time more efficiently.

Q5. How would you describe AI in one word?

As I mentioned earlier, AI is like navigation. When you are on your way to a city far away, your navigation guides you how to get there fast like a coach. However, if your navigation misleads you, then you won't use it any more. Similar to that metaphor, AI is a good guide. By sharing feedback, we can improve AI together and achieve improved clinical outcomes in the end.

What do the medical journals say?

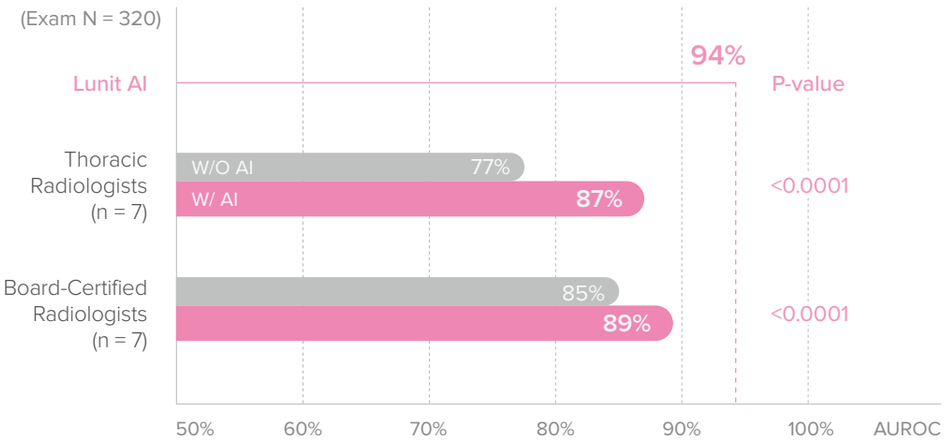
Below are highlights from the studies published in peer-reviewed journals that validate the performance of Lunit INSIGHT MMG and its clinical value in mammography interpretation.

JAMA Oncology THE LANCET Digital Health

Accurate and efficient diagnosis boosted with AI

HIGHLIGHT 1

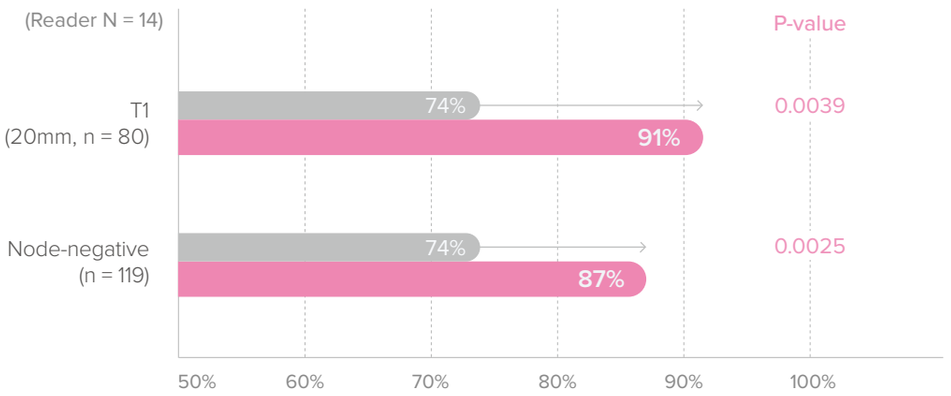
Improved reading performance of general radiologists and breast specialists.[6]



<Increased Breast Cancer Detection With AI>

HIGHLIGHT 2

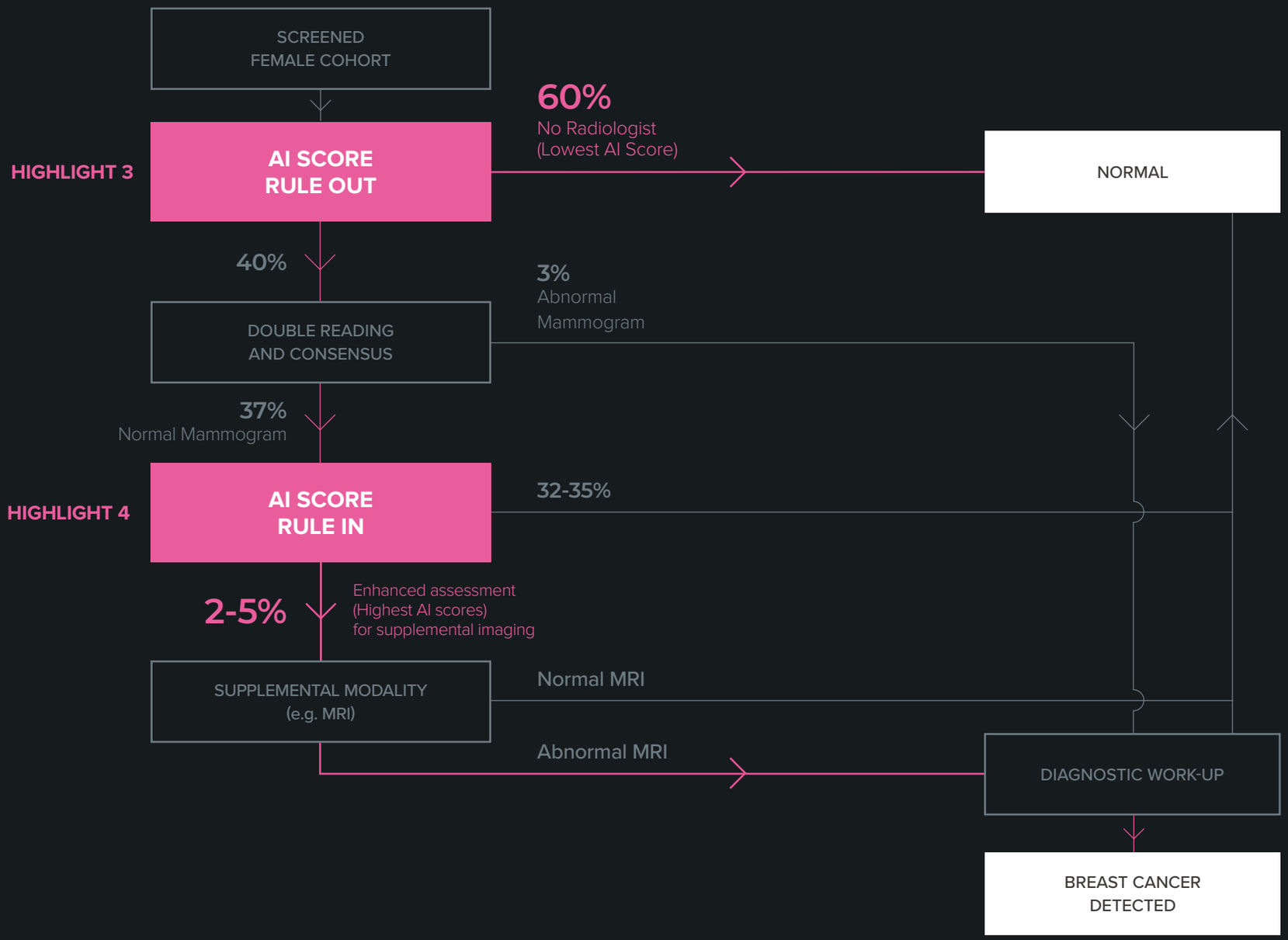
Detect early breast cancer such as T1 and node-negative breast cancer.[7]



<Early Breast Cancer Diagnosis Rate Improvement>

Simulated Triaging Workflow

This simulation features a triage workflow model, of which the AI score functions as a supportive information, that reduces radiologists' reading volume and complements their interpretations.



HIGHLIGHT 3

Triage 60% of the entire cases without missing any breast cancer.[8]

RULE OUT

60% of the entire cases with scores below a rule-out threshold could be triaged to a no radiologist work stream and interpreted as negative without missing any screen-detected cancer.

HIGHLIGHT 4

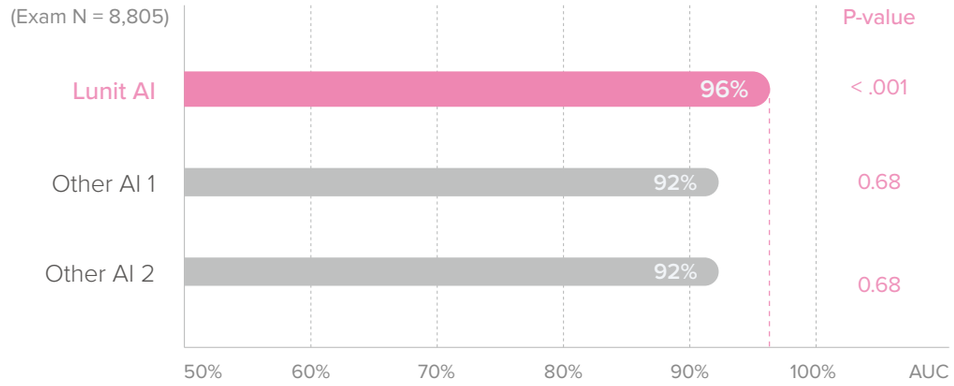
Detect more cancer cases originally interpreted by double reading as normal.[9]

RULE IN

Cases interpreted as normal but with scores above a rule-in threshold could be considered for supplementary breast imaging tests to detect more cancer that could have been missed.

HIGHLIGHT 5

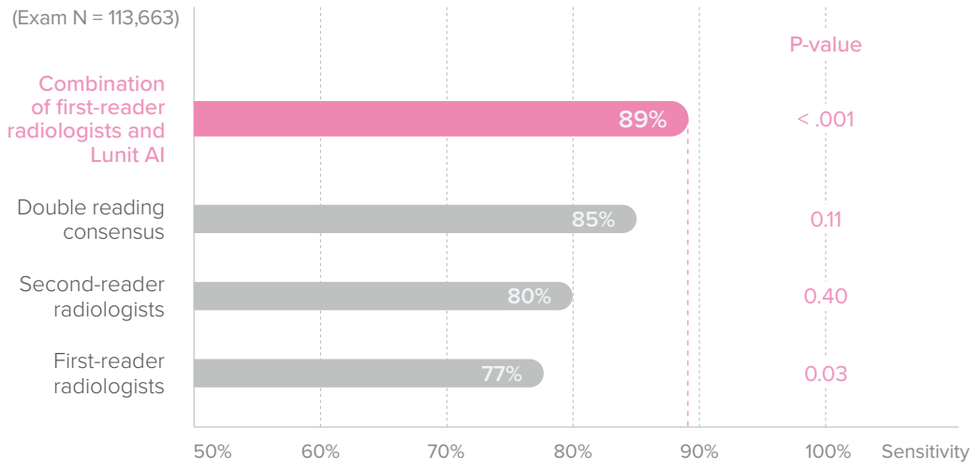
Lunit best detects breast cancer compared to other commercial AI solutions.[10]



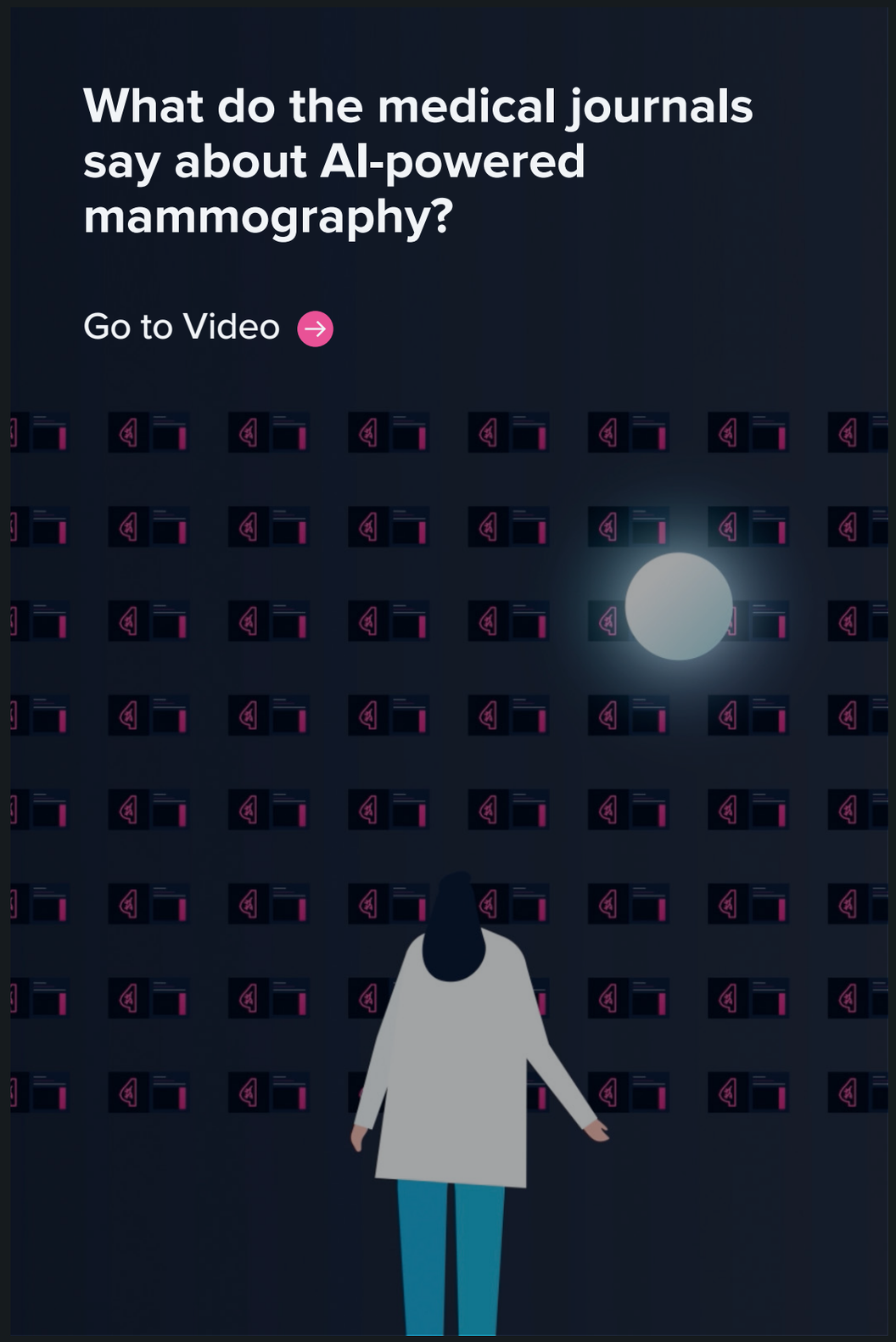
<Best Performance In Breast Cancer Detection Compared With Other AI Solutions>

HIGHLIGHT 6

Highest sensitivity when combined with first-reader radiologist.[11]



<Highest Sensitivity When Combined With First-Reader Radiologists>



User Interview

Dr. Bong-joo Kang

Medical Doctor at Catholic University of Korea
Seoul Saint Mary's Hospital in Korea.

Click to Watch

Q1. How do you use AI?

I read the most recent image first, and then compare it with the images from two or three years ago. While reading, I use two different systems: One is a CAD system and the other is an AI algorithm. The AI algorithm is Lunit's AI solution. I use both systems to double-check my findings.

Q2. How has AI improved your reading efficiency?

There are four images for a mammogram, and an extra two images generated by the CAD and the AI.
So I have six images to read in total.
You might be wondering if extra steps have increased the total reading time.
However, the time required to make judgements has been reduced, so the total amount of time remains almost the same. This can be seen while reading negative cases. If I think that there is no lesion and Lunit also says there is no lesion detected, then I can speed up my reading pace. On the other hand, if I have found nothing significant but Lunit says it's positive, then I try to reexamine the case. In conclusion, by spending less time on negative cases and focusing on positive cases, I can improve my reading efficiency.

Q3. What sets Lunit AI apart from previous CAD systems?

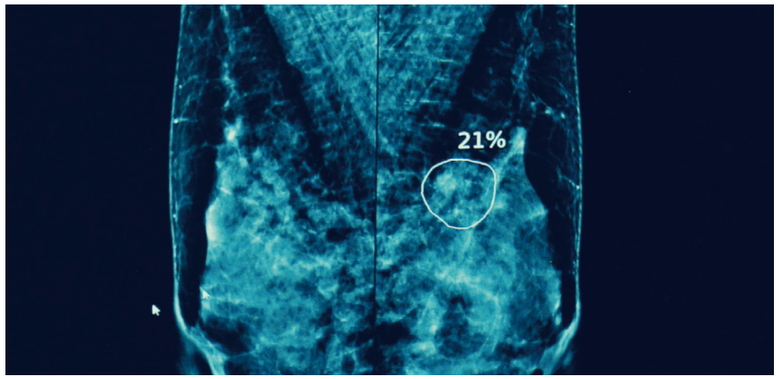
I have been using the CAD system for a long time. However, CAD algorithm tends to detect almost all dense breast cases, including those with calcification in them, as positive. So there have been quite a lot false positive cases because of the previous CAD system. In contrast, Lunit AI is based on an algorithm that has been trained on large datasets, so it rarely gives false positive readings. For example, Lunit AI can discern dense breast cases and vascular calcification cases. Overall, Lunit AI seems to be more reliable to refer to than the previous CAD systems.

Q4. Are there any cases where Lunit AI has been used to identify false negative readings?

Yes, there have been a few cases. When we were reading these cases, we didn't see any abnormalities. But during ultrasound exams, we found something suspicious. Then we checked the Lunit AI result to find that they had been identified as positive cases. In particular, for extremely dense breasts, it's hard to find abnormalities on mammograms. However, Lunit AI detects abnormalities that are only visible on ultrasound, and flags them as positive cases. If we conduct mammograms for extremely dense breasts and are able to diagnose them as positive cases with AI, then we can order follow-up exams such as ultrasound for further evaluation.

Q5. What clinical settings do you think would benefit from the use of AI the most?

First of all, AI can play the role of the second-reader in most clinical settings. In particular, Korean patients have relatively small breasts, and it's quite difficult to place the breasts into the frame. That's why quality control is very important in Korea. And for initial exams without previous images, you have to be more sensitive when reading those cases. And there are asymptomatic cases to screen. So if your hospital has the need for quality control, and many initial exams as well as normal cases to screen, you could make the most of Lunit AI by using it for double-checking and quality assurance. As a breast specialist, I still ask my colleagues for second opinions. Entry-level radiologists must do the same. When I'm reading some case and I feel uncertainty, I usually ask my colleagues sitting next to me and even ask other breast specialists, "What do you think about this case? Which category would you place it in? 4A or 3?" Discussing with your peers certainly helps improve your reading accuracy. However, if you read by yourself or work elsewhere other than a university hospital, it must be hard to exchange opinions. In those settings, AI can offer you a second opinion.



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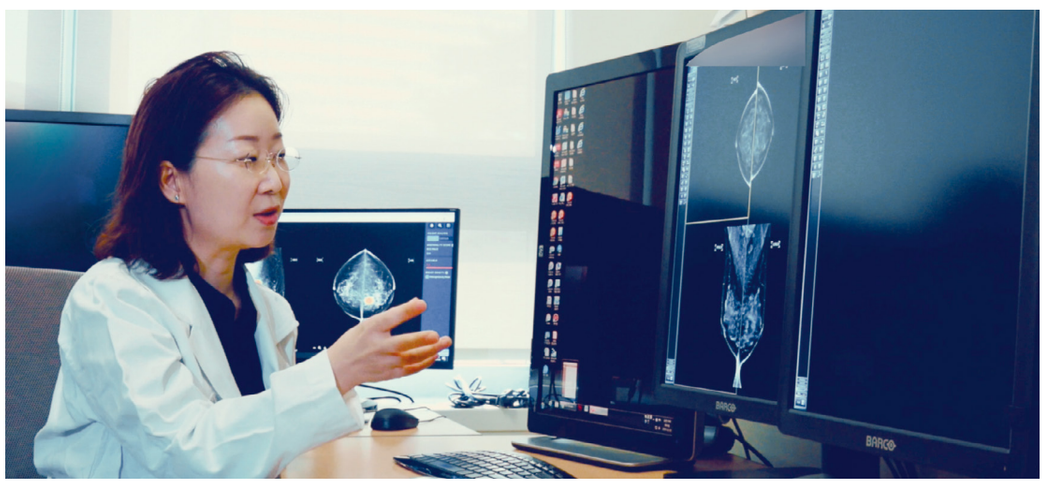
Lunit AI can discern dense breast cases and vascular calcification cases. Overall, Lunit AI seems to be more reliable to refer to than the previous CAD systems.



Special Interview

Dr. Fredrik Strand

Medical Doctor, Karolinska University Hospital in Sweden

Click to Watch

Q1. How is the breast screening environment in Sweden?

Every woman between 40 and 74 years old in Sweden is called or invited to come to screening with mammography every two years. We find only one out of 200 women with breast cancer and we recall about six women per 200. There are a lot of normal mammograms that we have to review.

Q2. What could be improved?

Two radiologists look at every image, so it takes a lot of time. That's one thing that could be possibly improved. And the other is that even though you go to screening, we miss about 30% of the cancer. So if you are woman and go to screening, you have only on average a 70% chance that it's screen detected.

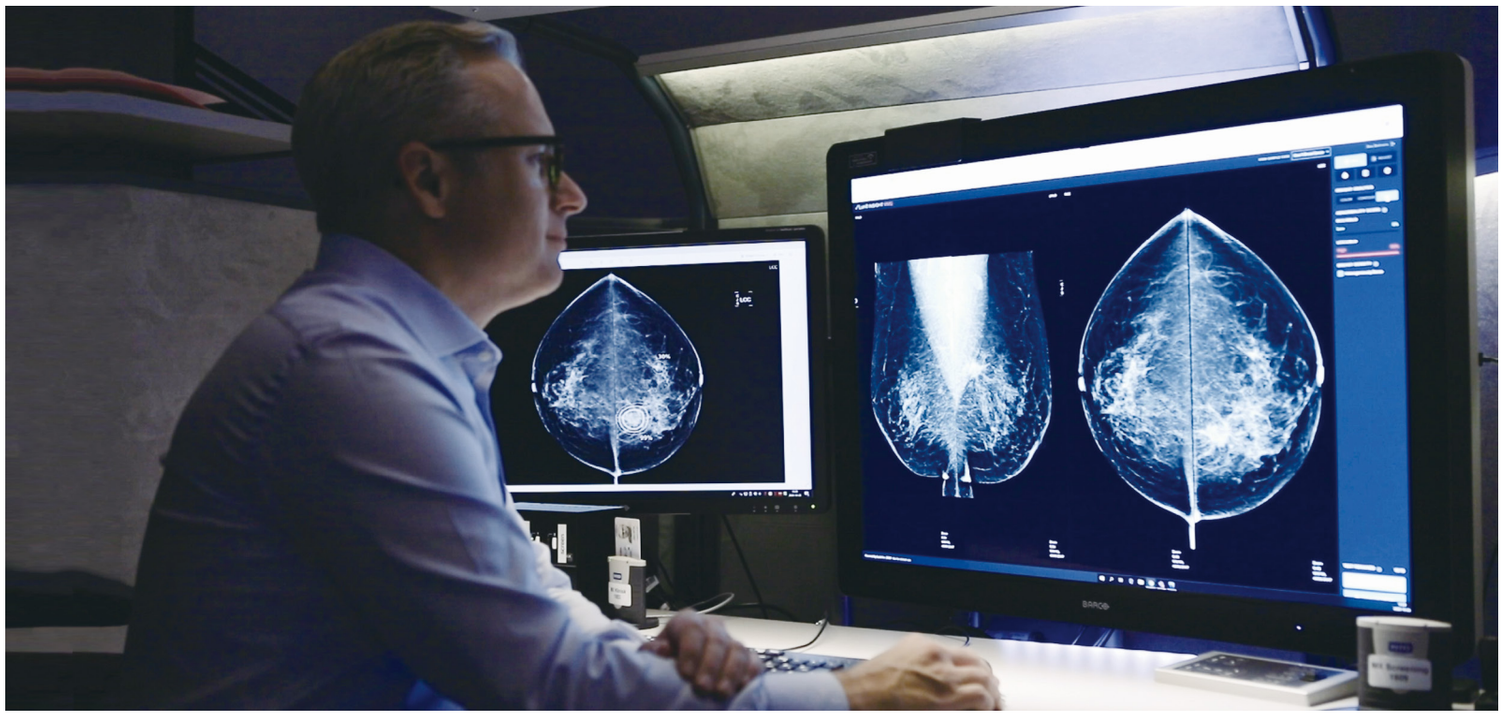
Q3. What are the results of your latest study about AI in cancer detection?

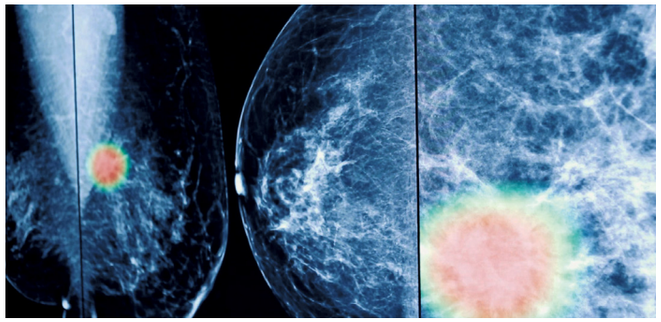
I was very interested in testing different algorithms on our data. And we had a pretty large data set of more than two million images in total. We asked companies if they wanted to be evaluated in our external data set. I was curious if the algorithms were basically the same or different from each other, and how their performance can be compared to our adiologists. We compared three different algorithms from three different companies. The study population consisted of 739 women diagnosed with breast cancer at the time of screening or within 12 months after screening. Then there were 8,000 healthy women included as well, and they were randomly sampled from the healthy population. The result showed very clearly that Lunit had a far better performance than the other two algorithms. Lunit had a very high AUC value, and the sensitivity was about 82%. The other two

algorithms had much lower numbers, with a sensitivity of around 67%.

Q4. How should AI be best implemented?

In our study, we found that combining the Lunit algorithm with one of the radiologists would have the highest sensitivity, compared to having either two AIs or two human radiologists. It would be better to have AI and a radiologist when it comes to sensitivity, finding the cancers. In Sweden, two readers interpret mammograms and then have a discussion for the suspicious cases. That discussion is between radiologists reviewing the images together and then we decide who to recall. If you use AI and a radiologist, there will be slightly more cases going to that consensus discussion.
Instead of discussing 3% of the population, you have to discuss 5% of the population. The workload will be significantly reduced by having AI anyway, even though you have slightly more discussions. There are so many healthy women that one radiologist would not have to look at, even if there is a slight increase in the discussions. I think the overall workload will be very much reduced.





> “
> **AI will really improve the value we deliver to the patient and the clinicians. It's important we are driving the change as radiologists.**

Q5. Any piece of advice for your peers?

If you're a radiologist, you should get involved with AI somehow. It's an unavoidable future for you and it's very exciting. And it's not something to be afraid of. It will really improve the value that we deliver to the patient and the clinicians. I think it's important that as radiologists, we are driving the change. We're driving it in the direction that we believe in, not only to reduce costs, but to improve patient outcomes. I think that it is very important to get involved and start using it.

Five-year survival rate when detected early by AI

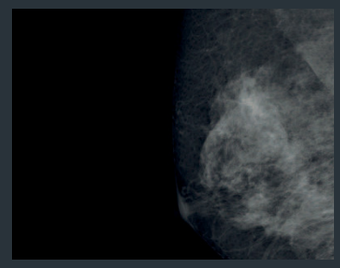
96%
When Detected Early By AI (stage 1-2)

65%
When Missed (stage 3-4)

Reference : AJCC 8th Edition

Lunit INSIGHT successfully analyzed the mammogram of a 59-year-old female patient, detecting breast cancer that had been missed since 2 years ago.

2008



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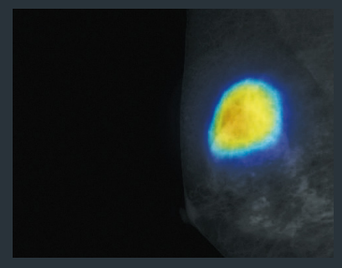
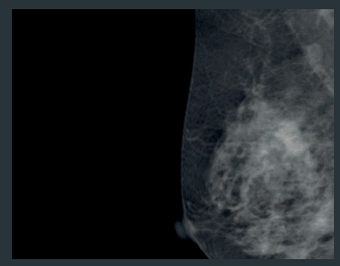


AI Score 71.2%
DETECTED

2009



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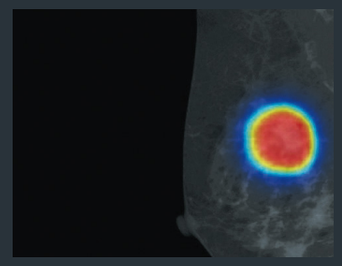
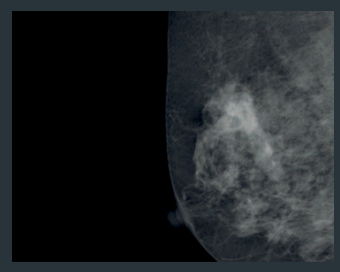
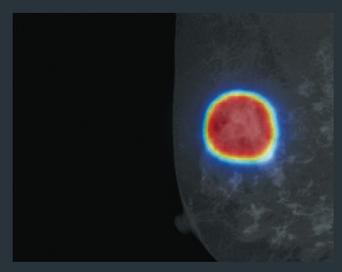


AI Score 91.8%
DETECTED

2010

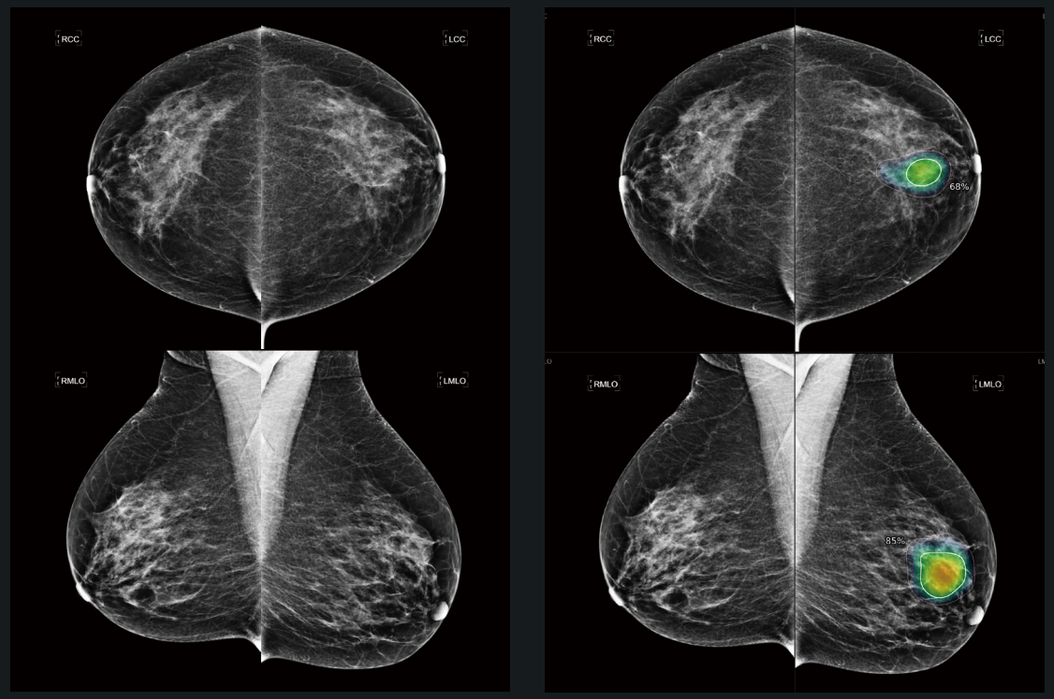


BREAST CANCER DIAGNOSED



AI Score 99.9%
DETECTED

Sample Cases

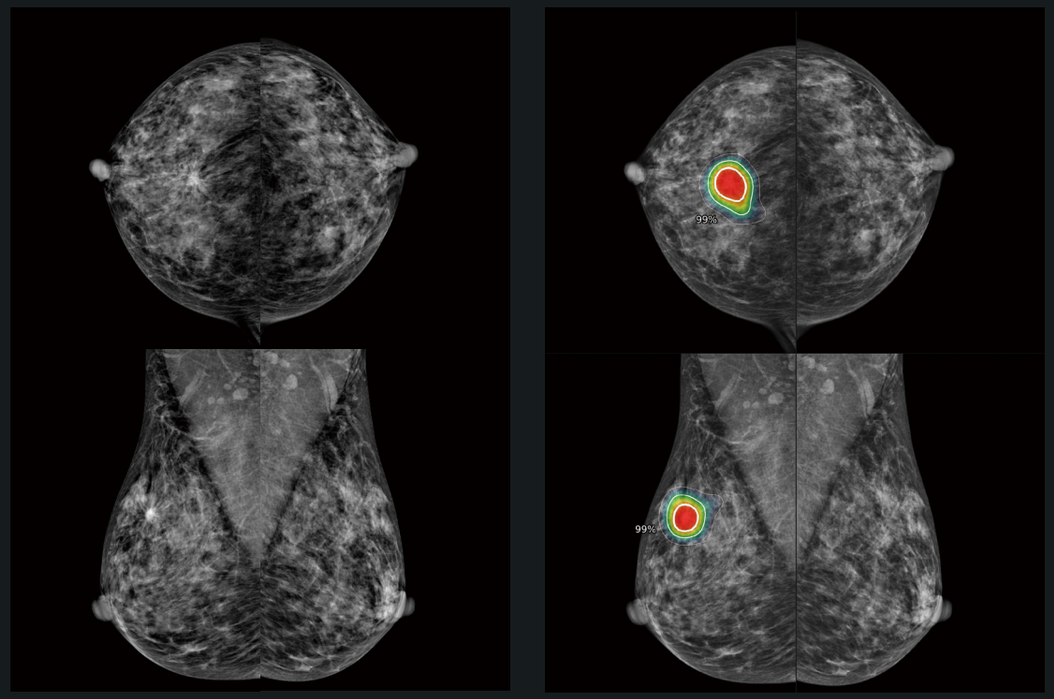


CASE 1

Biopsy proven cancer

Fine pleomorphic microcalcifications detected in the left breast.

L 85% *Abnormality Score*

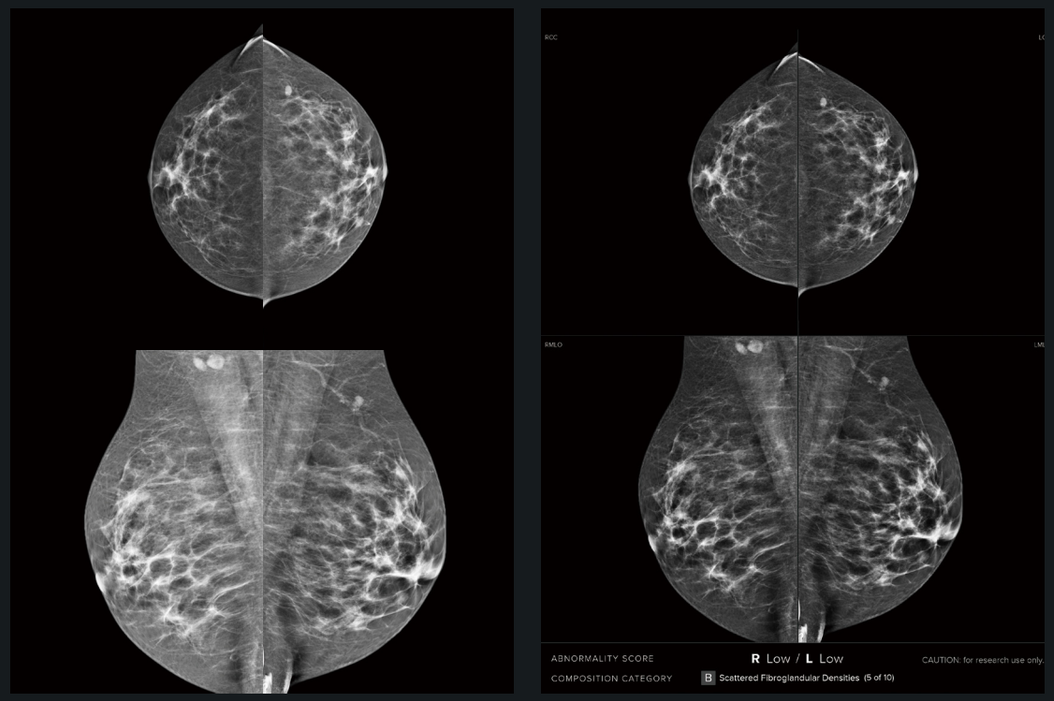


CASE 2

Biopsy proven cancer

Typical mass with microcalcifications detected in the right breast.

R 99% *Abnormality Score*



CASE 3

Negative, confirmed by follow-up images

Low *Abnormality Score*

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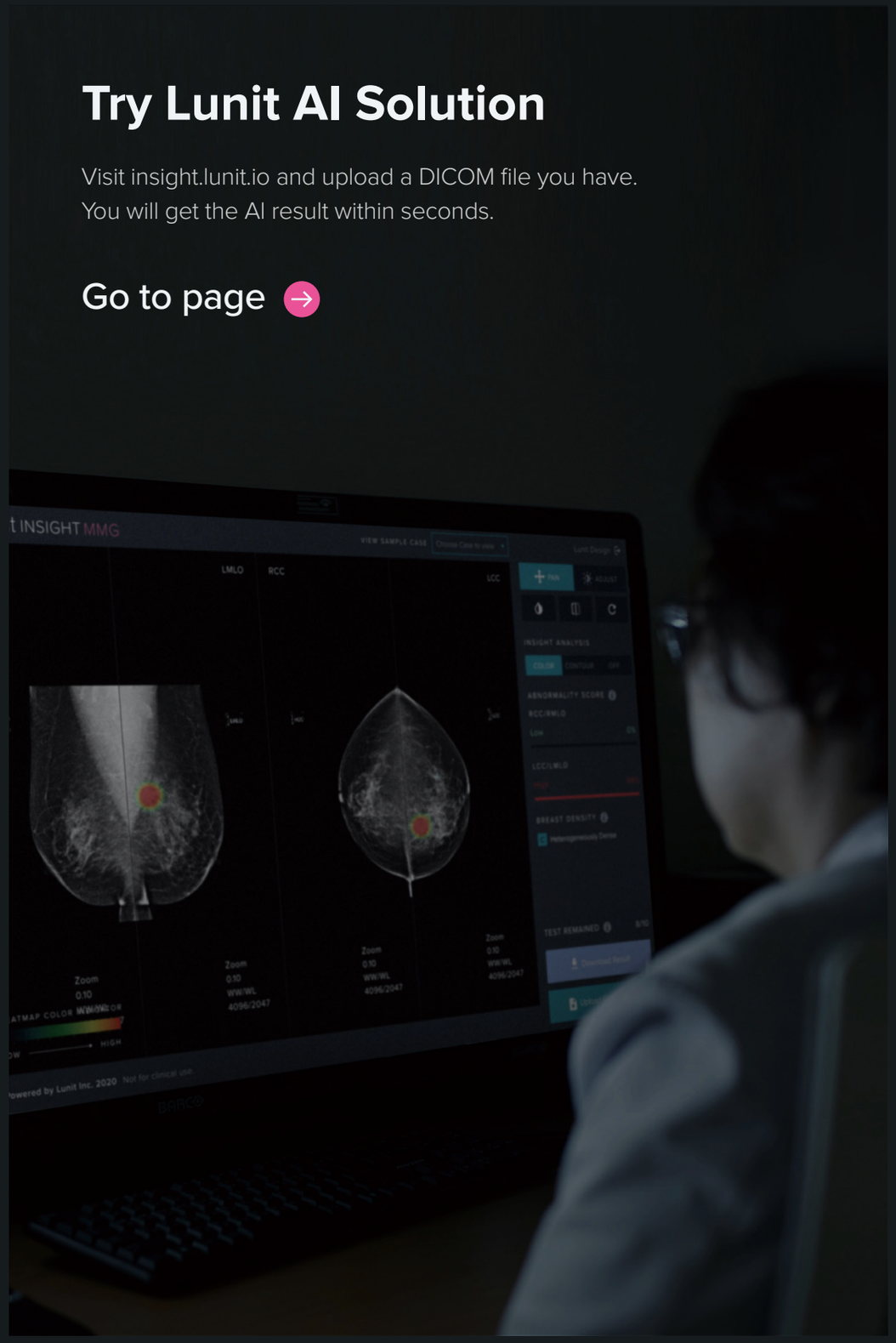
Go to page



Reference

User Benefits

[1] Mattie Salim, Erik Wåhlin, Karin Dembrower, et al. External Evaluation of 3 Commercial Artificial Intelligence Algorithms for Independent Assessment of Screening Mammograms. *JAMA Oncology.* 2020

[2] Karin Dembrower, Erik Wåhlin, et al. Effect of artificial intelligence-based triaging of breast cancer screening mammograms on cancer detection and radiologist workload: a retrospective simulation study. *THE LANCET Digital Health.* 2020

[3 4 5] Hyo-Eun Kim, Hak Hee Kim, et al. Changes in cancer detection and false-positive recall in mammography using artificial intelligence: a retrospective, multireader study. *THE LANCET Digital Health.* 2020

Clinical Validation

[6] Hyo-Eun Kim, Hak Hee Kim, et al. Changes in cancer detection and false-positive recall in mammography using artificial intelligence: a retrospective, multireader study. *THE LANCET Digital Health.* 2020

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[8 9] Karin Dembrower, Erik Wåhlin, et al. Effect of artificial intelligence-based triaging of breast cancer screening mammograms on cancer detection and radiologist workload: a retrospective simulation study. *THE LANCET Digital Health.* 2020

[10 11] Mattie Salim, Erik Wåhlin, Karin Dembrower, et al. External Evaluation of 3 Commercial Artificial Intelligence Algorithms for Independent Assessment of Screening Mammograms. *JAMA Oncology.* 2020

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Lunit Inc. 15 Floor, 27 Teheran-ro 2-gil, Gangnam-gu, Seoul, 06241, Republic of Korea

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Contact us

General - contact@lunit.io
Investment - ir@lunit.io
Media - media@lunit.io
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Contact Us

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