PERFECTING INTELLIGENCE, TRANSFORMING MEDICINE.

Corporate Overview

Lunit

About Us

Lunit, abbreviated from "learning unit," is a medical AI software company
devoted to developing advanced medical image analytics and
novel imaging biomarkers via cutting-edge deep learning technology.

Founded in 2013, Lunit has been internationally acknowledged for its advanced,
state-of-the-art technology and its application in medical images.
Lunit is based in Seoul, South Korea.

Perfecting Intelligence, Transforming Medicine.

With AI, we aim to make data-driven medicine the new standard of care.
We are especially focused on conquering cancer, one of the leading causes of death worldwide.

We develop AI solutions for precision diagnostics and therapeutics, to find the right diagnosis at the right cost, and the right treatment for the right patients.

Why Lunit?

With the recent breakthrough in machine learning and the large-scale digital medical data in hospitals, the world of medicine is entering into a new era of data-driven medicine.

Despite the advance, currently 28% of lung cancer and 32% of breast cancer cases are left unidentified and misdiagnosed.[1,2] High portion of medical cost is also gone wasted, with 95% of mammography being false positive[3] and 50% of diagnostic tests are considered unnecessary.

We want to change that.

We believe that improving diagnostic accuracy and reducing medical costs is key in providing quality care for patients. We are confident that our products can provide not just improved, but the best accuracy and efficiency possible.
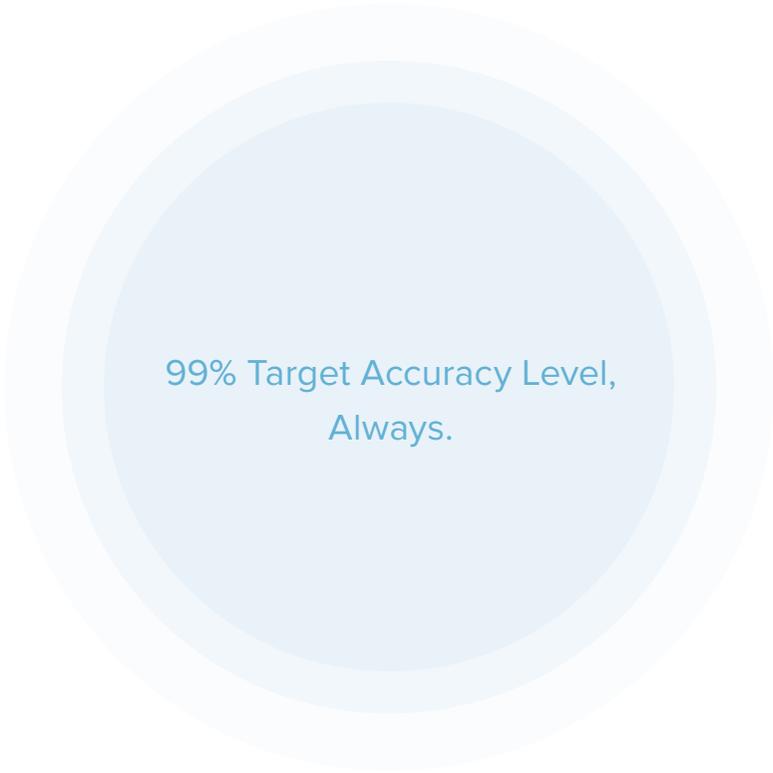
99% Target Accuracy Level,
Always.

1 Sources and effects of ionizing radiation: sources: United Nations Publications; 2000.
2 Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. CA Cancer J Clin 2015;65:87-108.
3 http://breastscreening.cancer.gov

Strong AI Team + Strong Medical Team

We have more than 20 deep learning experts working full-time to reach the pinnacle of technology. Our AI team has been internationally acclaimed in competitions, ranking top places at ImageNet 2015, Tumor Proliferation Assessment Challenge 2016, and Camelyon 2017, surpassing top companies like Google, IBM, and Microsoft.

Lunit was chosen by CB Insights as one of top AI startups in the healthcare industry (2017 AI 100, 2019 Digital Health 150) and was recognized by NVIDIA as Top 5 AI startups for social impact.

Our medical team consists of 6 full-time, board-certified medical directors and more than 15 part-time staff radiologists and pathologists.

They steer overall clinical direction, ensuring collection of large-scale high quality medical data and are directly involved in providing expert opinion everytime our AI algorithms are updated. Many of our studies and papers have been published at prestigious publications.

State-of-the-Art Technology

Deep Learning

Our proprietary, state-of-the-art deep learning technology combined with appropriate data construction enables us to achieve perfection in our intelligence, attaining super-human capabilities in detecting challenging cases, or cases not visible to the human eye.

Our technology had gained world recognition for its excellency and accuracy,
along with its sophisticated level of digital craftsmanship.

Competitive Data Acquisition

18 PARTNERS	**Globally throughout US, UK, and South Korea** Through partnership with healthcare institutions, we are able to collect/curate large-scale data and conduct multi-center clinical studies. Our partnership institutions are located throughout the world: US, South Korea, and UK.
+1M IMAGES	**Massive scale medical imaging data** Collection and curation of large-scale medical imaging data is what makes our state-of-the-art AI algorithms. We make sure to collect high-quality data, which so far have reached over 1 million case images.
F/U-CONFIRMED DATA	**Robust ground truth, highest quality** We collect confirmed data, not limited to suspected cases, but data with confirmed diagnosis and with robust ground truth, confirmed by pathology or further imaging data.

AI Publications by Lunit

ICCV 2019	SRM: A Style-based Recalibration Module for Convolutional Neural Networks
ICCV 2019 Workshop	Photometric Transformer Networks and Label Adjustment for Breast Density Prediction
MICCAI 2019	PseudoEdgeNet: Nuclei Segmentation only with Point Annotations
CVPR 2019	Learning Loss for Active Learning
NIPS 2018	Batch-Instance Normalization for Adaptively Style-Invariant Neural Networks
ECCV 2018	Convolutional Block Attention Module
BMVC 2018	Bam: Bottleneck Attention Module
CVPR 2018	Distort-And-Recover: Color Enhancement Using Deep Reinforcement Learning
MICCAI 2018	A Robust and Effective Approach Towards Accurate Metastasis Detection and PN-Stage Classification in Breast Cancer
MICCAI 2018	Keep and Learn: Continual Learning by Constraining the Latent Space for Knowledge Preservation in Neural Networks
MICCAI 2017 DLMIA Workshop	Accurate Lung Segmentation Via Network-Wise Training of Convolutional Networks
MICCAI 2017 DLMIA Workshop	A Unified Framework for Tumor Proliferation Score Prediction in Breast Histopathology
ICLR 2017 Workshop	Transferring Knowledge to Smaller Network with Class-Distance Loss
MICCAI 2016	Self-Transfer Learning for Fully Weakly Supervised Object Localization
ECCV 2016	Pixel-Level Domain Transfer
ICCV 2015	Attentionnet: Aggregating Weak Directions for Accurate Object Detection
CVPR 2015 DeepVision Workshop	Multi-scale Pyramid Pooling for Deep Convolutional Representation

Precision Diagnostics

Our research and development in precision diagnostics focus in finding the right diagnosis at the right cost by using AI. We aim to bring beyond expert-level detection of abnormal findings with significant decrease in overall reading time. This can lead to a timely diagnosis of urgent cases and a decrease in unnecessary tests.

Lunit INSIGHT

We aim to bring exceptional, clinically-approved accuracy to our products.

The accuracy level of our current diagnostic products for chest x-ray and mammography ranges from 97% to 99% depending on the area of diagnosis.

The location of detected lesions are shown in heatmap which also reflects the abnormality score. The higher the abnormality score, the heatmap is colored in red.

According to our studies, our precision diagnostics products have been proven to successfully aid the radiologists in the detection of a lesion, improving reader performance by up to 20%. It also increases breast cancer detection by 24% with reduced false positive recalls.

We also make our product most accessible for our users to improve productivity. Our products can be seamlessly integrated into the clinical workflow, deployed both on-prem and via cloud.

For Chest X-Ray

Lunit INSIGHT CXR

Augmented Detection, Enhanced Workflow
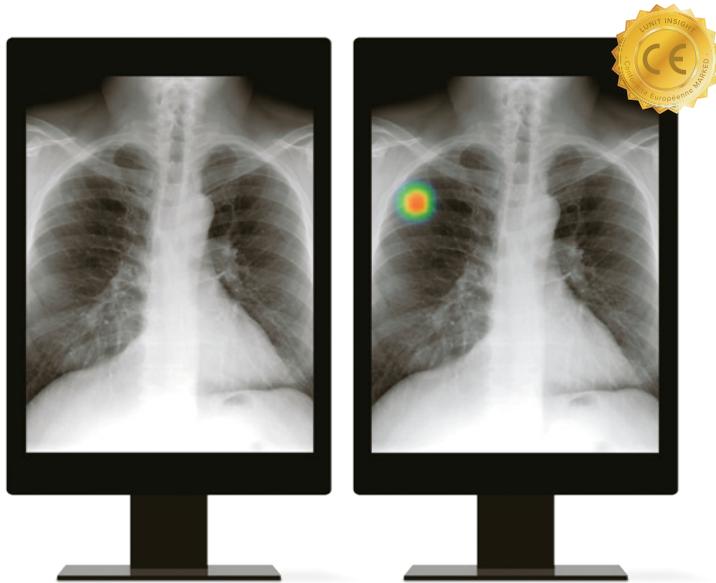
For Mammography

Lunit INSIGHT MMG

Increased Findings, Reduced Biopsies

Lunit INSIGHT CXR

97 - 99% AUC for Chest Abnormality Detection

Although chest radiography is the most commonly used — 25% of the annual total numbers of diagnostic imaging procedures, thus being the most fundamental imaging test — the interpretive performance is suboptimal, where 20-30% are reported to be missed. The ever growing burden for physicians is intensified with high volume of image to interpret.

Lunit INSIGHT CXR is the solution to this problem. With an accuracy level that reaches 97-99%, it detects lung nodule/mass, consolidation and pneumothorax within seconds.

You can login to https://insight.lunit.io to freely upload chest x-ray DICOM images and get real-time diagnosis results conducted by Lunit INSIGHT in no time.

Sofware ver.	Features
Lunit INSIGHT CXR 1	Detects lung nodule
Lunit INSIGHT CXR 2	Detects 3 major findings: nodule, consolidation, pneumothorax
Lunit INSIGHT CXR 3 · CE Marked ·	Detects 10 major findings: nodule, consolidation, pneumothorax, atelectasis, calcification, cardiomegaly, fibrosis, mediastinal widening, pleural effusion, pneumoperitoneum.

Main Features

☑ Average 98.7% AUC

☑ Heatmap presentation
(grayscale for black and white monitors)

☑ Abnormality score

☑ PACS integration supported

☑ Worklist triage supported

☑ Trained with over 200k chest x-ray images

☑ CE Marked
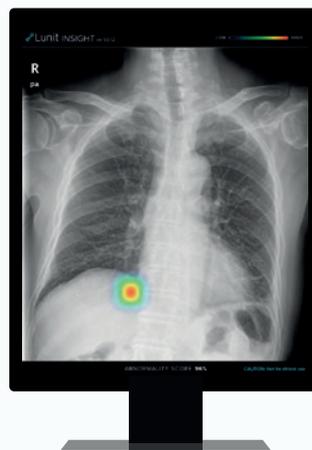
Heatmap Presentation
in Colored Monitors

Grayscale Presentation
in Black & White Monitors

Lunit INSIGHT CXR Reader Study

Nam JG, Park SG, et al. Development and Validation of Deep Learning-Based Automatic Detection Algorithm for Malignant Pulmonary Nodules on Chest Radiographs. Radiology. 2018 Sep 25:180237.

According to our reader study for detection of lung nodule in chest radiography, the accuracy of Lunit's algorithm was the highest among the entire group of readers, including thoracic radiologists and board-certified radiologists.

It has proven that with Lunit INSIGHT CXR as a second reader, physicians of different expertise level showed statistically significant increase in detection performance. For non-radiology physicians, the performance level significantly increased upto 20%.

The Accuracy of our Algorithm is High (Image N=181)
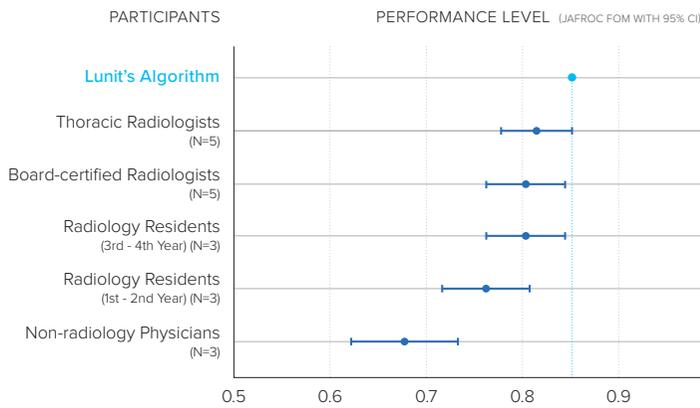
Our Algorithm Makes Radiologists Better (Image N=181)
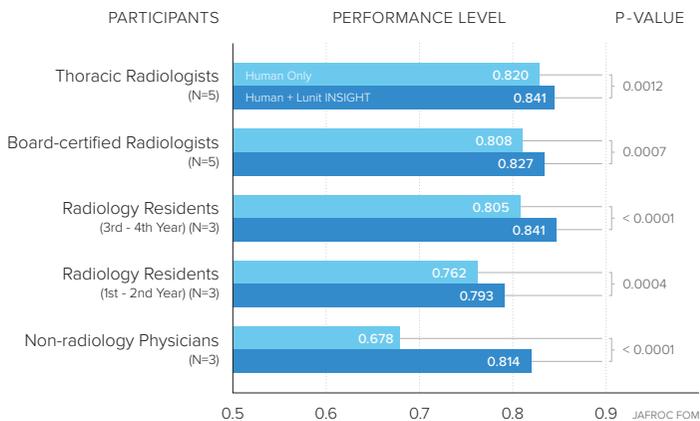
Lunit INSIGHT MMG

97% AUC for Breast Cancer Detection

Breast cancer is one of the most common cancerthat takes up 25% of the entire cancer and is the leading cause of death, at 15%, among women worldwide. Screening mammography is the only single modality proven to improve breast cancer survival, with a mortality reduction rate of around 20%.

However, accuracy of screening mammography is low, with false negative rates of 10-30% and false positive rates around 95%. Proportion of breast specialists reading screening mammograms is also low.

Lunit INSIGHT MMG provides solution to this problem by detecting breast cancer lesions with 97% accuracy within seconds.

Lunit INSIGHT MMG was trained by over 200,000 mammography cases of which approximately 50,000 cases were from breast cancer patients.

You can login to https://insight.lunit.io to freely upload mammography DICOM images and get real-time diagnosis results conducted by Lunit INSIGHT in no time.

Main Features

- ☑ Average 97% AUC

- ☑ Heatmap presentation
     (grayscale for black and white monitors)

- ☑ Abnormality score

- ☑ Ignores benign lesions

- ☑ PACS integration supported
     (50k breast cancer cases)

- ☑ Korea MFDS approved

Heatmap Presentation
in Colored Monitors
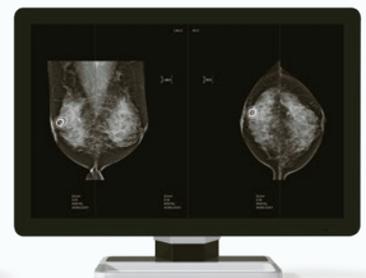
Grayscale Presentation
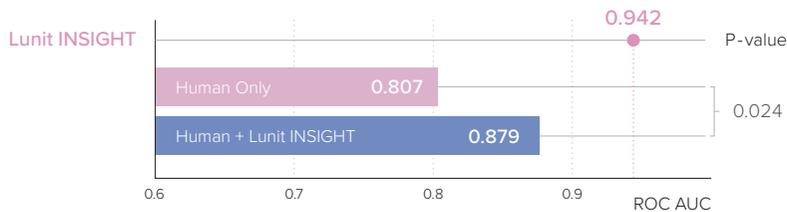in Black & White Monitors

Lunit INSIGHT MMG Reader Study (RSNA 2018)

Data-Driven Imaging Biomarker for Breast Cancer Screening in Mammography-Reader Study, RSNA 2018
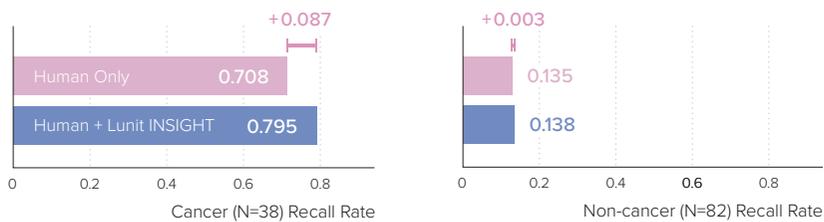
Clinical studies have shown Lunit INSIGHT MMG to enable radiologists to perform significantly better in detecting malignant cases, with increased performance level by 10%.

When Lunit INSIGHT MMG was directly compared to traditional CAD, its performance level was superior by a large margin, especially in terms of specificity, which has been the major issue with traditional CAD.
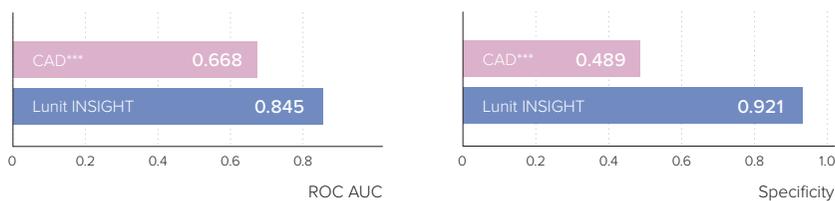
Comparison with Radiologists for Cancer Detection*
(Exams N=120)

Lunit INSIGHT — 0.942 — P-value

Human Only — 0.807

Human + Lunit INSIGHT — 0.879

0.024

0.6   0.7   0.8   0.9   ROC AUC

Comparison with Radiologists for Recall Rate**
(Exams N=120)

+0.087

Human Only — 0.708

Human + Lunit INSIGHT — 0.795

0   0.2   0.4   0.6   0.8   Cancer (N=38) Recall Rate

+0.003

0.135

0.138

0   0.2   0.4   0.6   0.8   Non-cancer (N=82) Recall Rate

Comparison with CAD*** for Cancer Detection
(Exams N=76)

CAD*** — 0.668

Lunit INSIGHT — 0.845

0   0.2   0.4   0.6   0.8   ROC AUC

CAD*** — 0.489

Lunit INSIGHT — 0.921

0   0.2   0.4   0.6   0.8   1.0   Specificity

*Based on reader's rating (DMIST 7pt score) for likelihood of malignancy (LOM) w/ and w/o Lunit INSIGHT
** Based on reader's binary decision whether each case should be recalled w/ and w/o Lunit INSIGHT
*** CAD denotes analysis results from a commercially available computer aided detection software

How Lunit INSIGHT Works

Our products are developed to be seamlessly integrated and applied in various clinical settings, available for deployment at institutions that use either cloud-based systems or on-premise hardware.

Once a patient takes an x-ray, the original image is transferred to PACS system. From the PACS, the image goes through de-identification process via Lunit gateway server. The gateway sends the decrypted image information to our AI engine, which makes the AI analysis.

The analyzed image is then sent back to the PACS through our gateway, providing instant AI result for the physician to read. This process all happens within seconds.
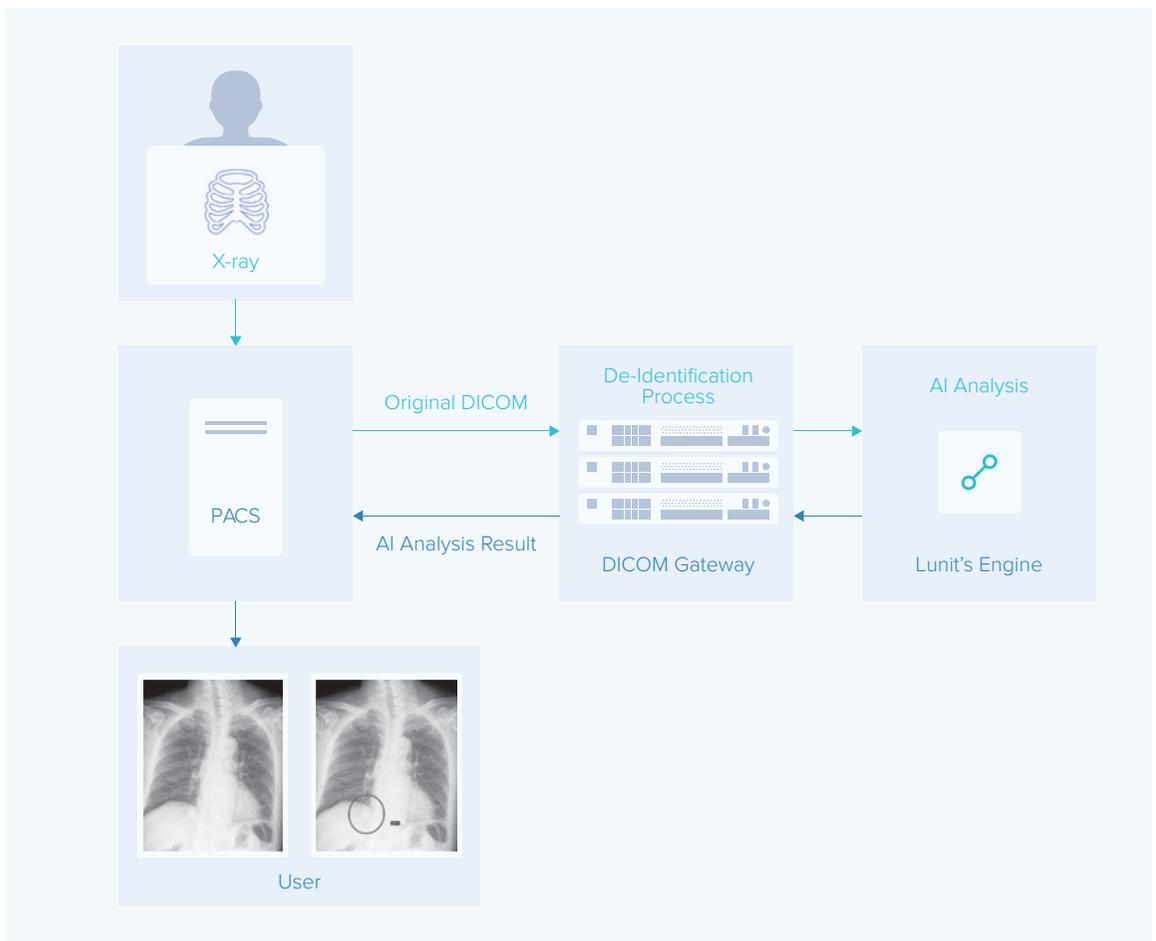
Installation Options

DICOM Gateway

Our products can be integrated into DICOM standard environment ; there is no need to transfer data outside local premises when using on-premise hardware.

Cloud Base SaaS API

Our products can be integrated into HTML5 -based DICOM viewers or other forms of native application via RESTful API; HIPAA-compliance will be supported; suitable for cloud-based PACS system or other image sharing platforms.

A software engineer from Lunit is installing the software on the hospital premise. Once the installation is completed, the software is ready to use within the hospital's PACS system.

Global Use of Lunit INSIGHT

Lunit INSIGHT is being deployed and tested throughout the world in various reference sites, including Mexico, UAE, South Korea, Thailand, and etc. As of November 2019, Lunit INSIGHT has analyzed a total number of 2.3 million images from over 80 countries around the world.

Lunit INSIGHT products are being used at university hospitals, teleradiology firms, Tuberculosis (TB) screenings, in military settings, health check-up hospitals, and etc.

Our chest x-ray solutions are being applied in TB screening systems in Korea, simplifying a two-step process of tuberculosis screening into a more efficient, one-step process, in which sputum samples can be collected on site, right after the preliminary screening with our AI solution.

We are also in partnership with STOP TB Partnership, selected to participate in TB Reach Wave 7 project in the beginning of 2020. Under an agreement with Republic of Korea army, we also plan to provide our solution for remote and isolated military camps with limited access to specialists.

Furthermore, our product serves as a solution for high-volume settings to "double-check" and make sure important findings are not left unnoticed.
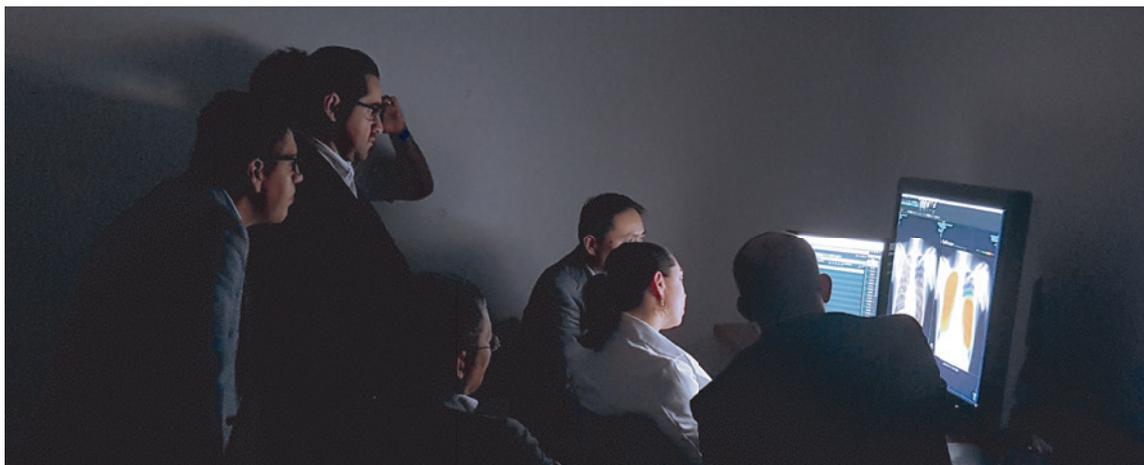
Lunit INSIGHT Demo User Map

Total Number
of Countries
▼

80+

2.3M+

▲
Total Number
of Images
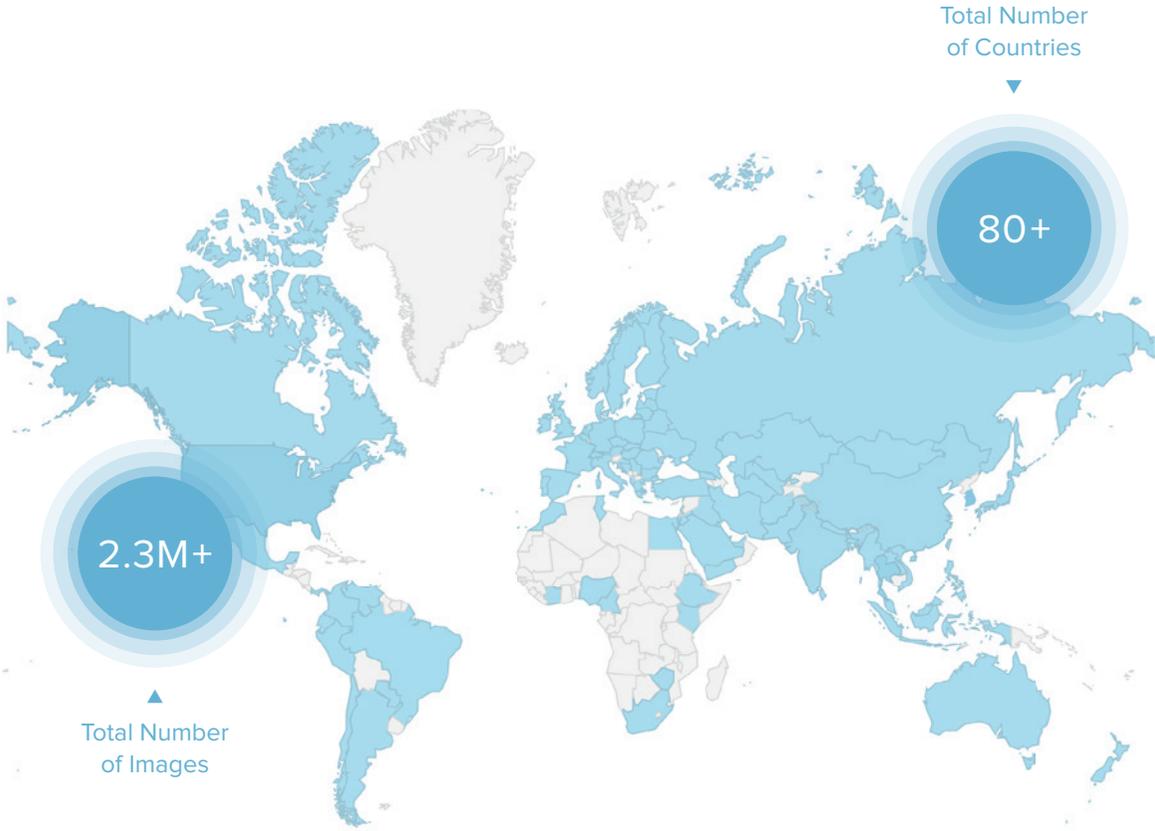
Precision Medicine

Our research and development in precision medicine focus in finding the right treatment for the right patients by using AI. We aim to develop AI-powered therapeutic biomarkers that can predict response to specific treatment and identify the optimal treatment for individual patients. We also seek to help identify more patients who can benefit from the right treatment.
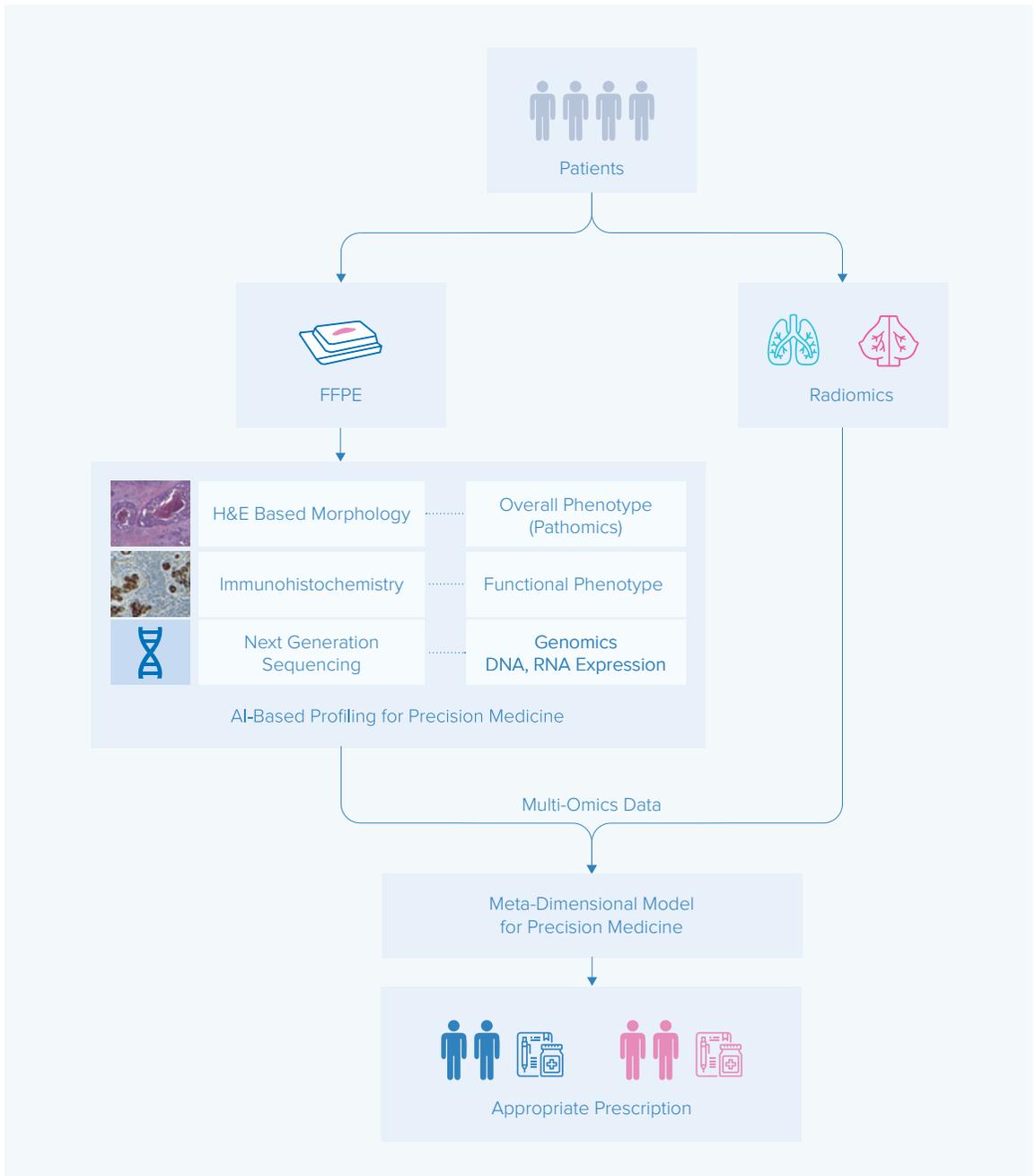
Our Vision: Therapeutic AI Biomarker

Our ultimate goal is to develop meaningful data-driven imaging biomarkers that would be clinically used to guide cancer diagnosis and treatment. Step by step, we are expanding the scope of our research to go beyond human vision into the realm of clinical outcome prediction.

We are fully committed to the current frontier of precision medicine where specific treatment is tailored for individual patients. Our primary goal is to discover highly predictive biomarkers with high clinical impact.

We plan to combine H&E-based histological information and immunohistochemistry information with molecular tests and radiology images to develop highly predictive biomarkers that reflect all biological aspects.

So far, our findings have been presented as an abstract at top international oncology conferences such as American Association for Cancer Research (AACR) and American Society of Clinical Oncology (ASCO).

Prediction of Future Clinical Outcome
to Guide Treatment Using Multi-Omics Data

Patients

FFPE

Radiomics

H&E Based Morphology ········· Overall Phenotype (Pathomics)

Immunohistochemistry ········· Functional Phenotype

Next Generation Sequencing ········· Genomics DNA, RNA Expression

AI-Based Profiling for Precision Medicine

Multi-Omics Data

Meta-Dimensional Model for Precision Medicine

Appropriate Prescription

For Oncology / Pathology

Lunit SCOPE

AI-Powered Tissue Phenotyping

Based on the quantitative assay of tumor micro-environment made by Lunit SCOPE, a deep learning-based histology analytics software, predictive data can be obtained from the analysis of each tissue samples.

Lunit SCOPE has been developed based on extensive annotations by 10+ board-certified pathologists to guide AI training.
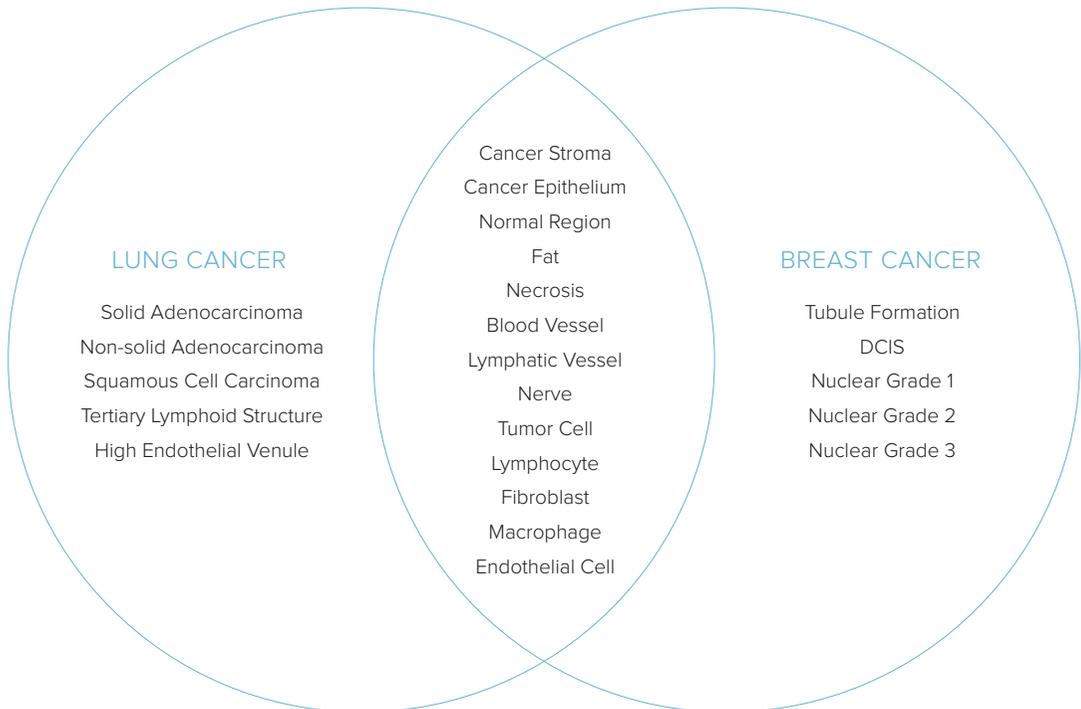
Additional AI technology for efficient annotation continues to improve the performance of Lunit SCOPE.

Currently, Lunit SCOPE supports various histologic features in lung and breast cancer. (Online demo available at https://scope.lunit.io)

Detectable Features

LUNG CANCER

Solid Adenocarcinoma
Non-solid Adenocarcinoma
Squamous Cell Carcinoma
Tertiary Lymphoid Structure
High Endothelial Venule

Cancer Stroma
Cancer Epithelium
Normal Region
Fat
Necrosis
Blood Vessel
Lymphatic Vessel
Nerve
Tumor Cell
Lymphocyte
Fibroblast
Macrophage
Endothelial Cell

BREAST CANCER

Tubule Formation
DCIS
Nuclear Grade 1
Nuclear Grade 2
Nuclear Grade 3

Project Status

Currently, Lunit SCOPE supports H&E image analysis from breast and lung cancer.
We plan to expand to H&E and IHC image (e.g. PD-L1) analysis in pan-cancer.

Future Development Plans

Precision Diagnostics

Chest Computed Tomography

Lung cancer screening by low dose chest CT has been demonstrated to have survival benefit. Starting with accurate detection of lung nodules in chest CT, we plan to develop an imaging biomarker that accurately predicts malignancy of the detected nodules. Through the use of such imaging biomarker, not only will unnecessary invasive biopsy procedures may be avoided, but it may also be used to diagnose lung cancer at an earlier stage.

Digital Breast Tomosynthesis (DBT)

DBT has been demonstrated by various large-scale studies to be superior to mammography in terms of breast cancer screening performance. We are using our experience in mammography research to develop a highly accurate diagnostic algorithm for breast cancer detection in DBT.

Precision Medicine

AI-Based Predictive Biomarker Assay

Breast Cancer	Prediction of post-op IDC upgrade of DCIS patients.
Lung Cancer	Tissue-agnostic predictive biomarkers for immunotherapy.
Colon Cancer	Prediction of consensus molecular subtypes from H&E images. Predictive biomarker for adjuvant chemotherapy in colon cancer patients.

Partner with Us

We are looking for worldwide partnership with healthcare providers and companies interested in integrating our products and services.

Please reach out via email to partner@lunit.io for inquiries.

Corporate Partners

FUJIFILM

Microsoft Azure

Dongkook lifescience

NVIDIA

NUANCE

ENVOY AI

INFINITT Healthcare

Hewlett Packard Enterprise

Contact Us

Please feel free to email us about any inquiries or questions.

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www.lunit.io