

**VIEW
THE INVISIBLE
KNOW
THE UNKNOWN**


VUNO®

VIEW THE INVISIBLE
KNOW THE UNKNOWN



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VIEW THE INVISIBLE KNOW THE UNKNOWN

VUNO is one of the biggest healthcare AI companies in the world with strong commercial traction of road-tested and clinically-proven solutions.

Founded back in December 2014, the company successfully obtained the 1st Korean FDA (MFDS) approval for medical AI software. Since then, VUNO has rapidly expanded its product portfolio to a diverse and comprehensive line up, that is reshaping the delivery of medical imaging diagnostics in the field of radiology, pathology, bio-signal and medical speech recognition.

A proven track record of success in winning international technical challenges coupled with a series of regulatory approval and commercial deployments to over 500 hospitals, make VUNO an undisputed leader in the global medical AI arena.

VUNO
in numbers

+10

Successfully developed
& deployed
AI-based medical
solutions

+16

MFDS approval and
CE certifications
More VUNO Med®
solutions are currently
under FDA review

+60

Patents in AI core
technology, disease
detection & diagnosis

+60

Academic publications
and presentations in /
at prestigious medical AI
journals / conferences

+170

Industry experts dedicated
to medical AI R&D

+500

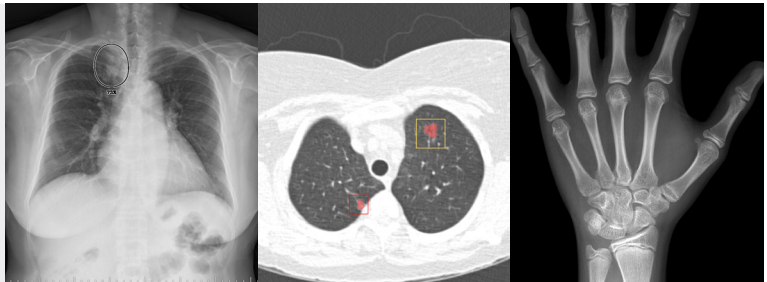
No. of hospitals / clinics
actively using
VUNO solutions

Navigate Ambiguity – Any Specialty, Anywhere with VUNO Med® Solutions

Medical Imaging

Automatic lesion detection;
quantification using 2D & 3D medical
images; fundoscopic images

- Abnormality screening
- Probability scores for detected lesions



Biosignals

Biosignal based (e.g., vital signs,
ECG) diagnostics support and risk
prediction

- Patient monitoring
- Quantification of risk prediction
- Early warning of adverse event



Pathology

AI-based detection and quantification
of malignant cells using digitally
scanned pathology image

- Morphometric analysis
- Diagnostic support
- Biomarker discovery



Medical speech

AI-based automatic real-time chart
production

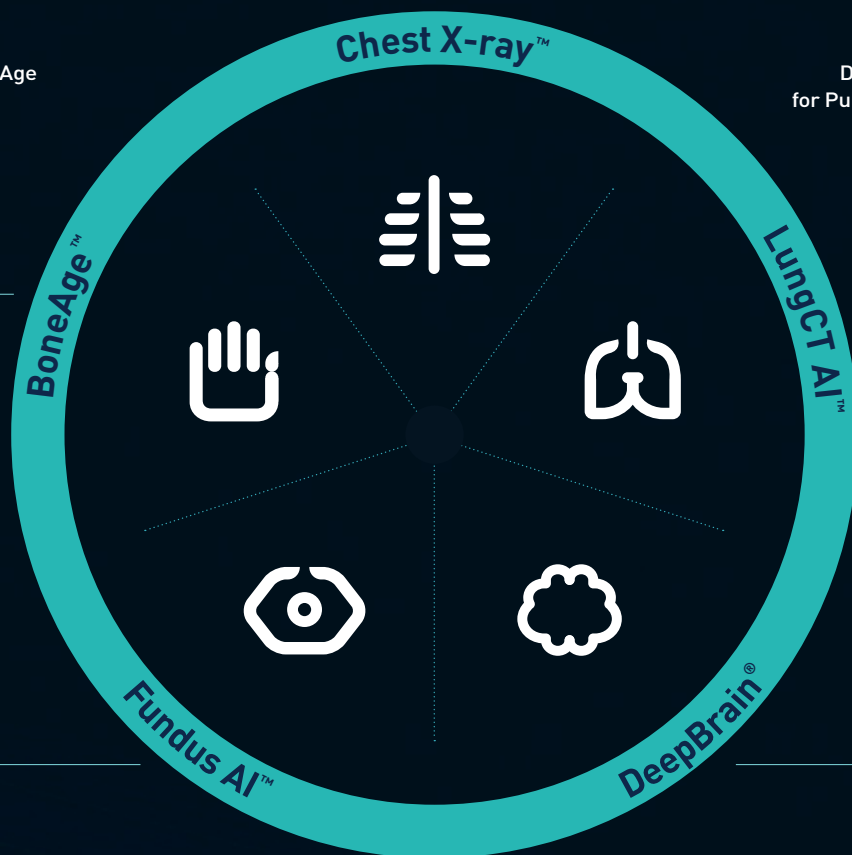
- Dictation for medical reports
- Customized voice recognition



Diagnostic Support System for Abnormalities in Chest X-ray

Automatic Bone Age Assessment

Detection Solution for Pulmonary Nodules in Chest CT



Screening Solution for Various Fundus Abnormalities and Ocular Diseases

Brain Parcellation for the Quantification of Neurodegenerative Diseases



VUNO Med®

Chest X-ray™

Introduction

AI-based Diagnostic Support System for Abnormalities in Chest X-ray

VUNO Med®-Chest X-ray™ accurately and instantly detects and flags suspected chest abnormalities indicative of major pulmonary diseases from chest X-ray images.

The solution provides information on findings of chest related abnormalities, abnormality scores as well as their locations, maximizing the reading accuracy and efficiency of radiological reporting.

Key Features

Clinical Support

- Nodule/Mass
- Consolidation
- Interstitial Opacity
- Pleural Effusion
- Pneumothorax

- Detects presence of **5 lung abnormalities**, abnormality score and location based on PA and AP X-ray images
- Upcoming model will detect more than 10 lung abnormalities

Efficiency



- Detects abnormalities within **3 - 10 secs***

Integration

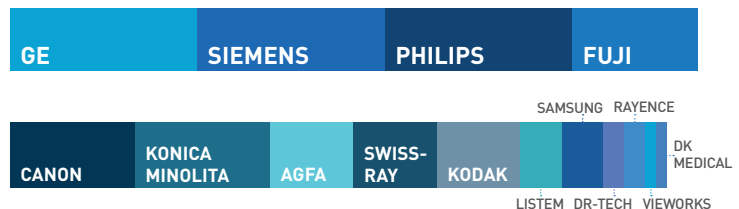


- Allows **PACS integration**
- Offers cloud-based service which requires no additional server installation
- **Embedded** into X-ray devices

* May vary depending on the internet speed and server environment

Performance Validation

Comprehensive Data



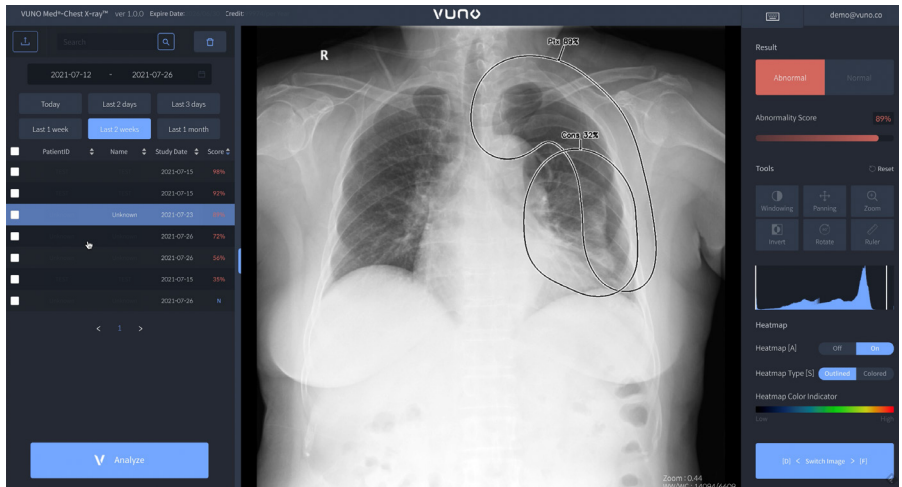
- Trained on chest X-ray images taken with imaging equipment from more than **15 global vendors**¹
- Reading accuracy of JAFROC FOM [0.96] and AUC [0.98]²

*AUROC, area under the receiver operating characteristic curve; JAFROC, Jackknife alternative free-response receiver operating characteristic curve; FOM, figure of merit; FP, false positive

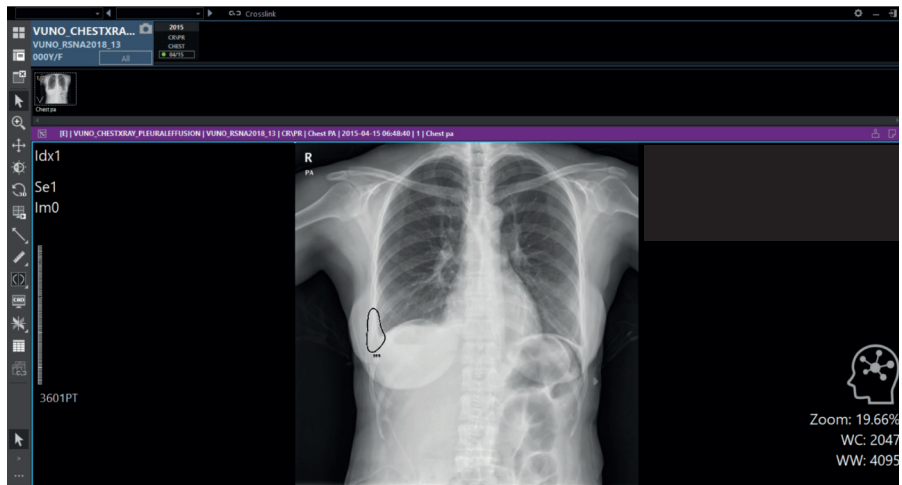
Reference

- 1) Woong, et al. Deep Learning based Automatic Chest PA Screening System for various devices and hospitals. Presented at: RSNA 2018 Scientific Assembly and Annual Meeting.
- 2) Jinkyong S, et al. Value of Deep Learning-based Detection System for Multiple Major Findings on Chest Radiographs: A Randomized Crossover Study. Mar 23 2021;202818.

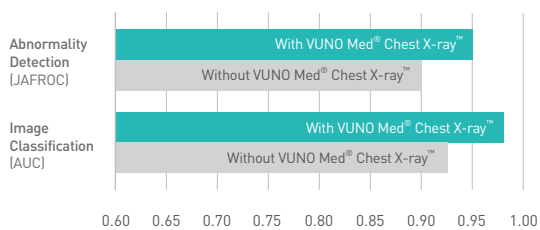
Product Screen



PACS Integration

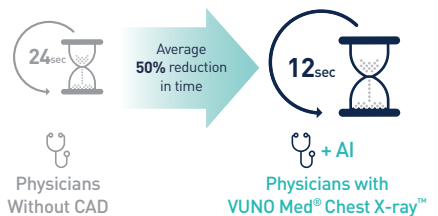


Reading Accuracy(%)



VUNO-Med Chest X-ray improved the reading performance of thoracic radiologists, general radiologists and residents¹

Reading Time(s)



VUNO-Med Chest X-ray reduced reading time by more than 50%¹

Reference

1) Added Value of Deep Learning-based Detection System for Multiple Major Findings on Chest Radiographs: A Randomized Crossover Study, Radiology, Mar. 2021



VUNO Med®

LungCT AI™

Introduction

Detection Solution for Pulmonary Nodules in Chest CT

VUNO Med®-LungCT AI™ is a detection solution for pulmonary nodules in chest CT scans. VUNO Med-LungCT AI detects the presence, types and locations of pulmonary nodules, and can predict their lung RADS score. The super-resolution algorithm optimizes nodule detection performance and enhances CT images.

Key Features

Clinical Support



- Accurate detection and **volumetric quantification** of pulmonary nodules
- Upcoming model will include enhanced **malignancy prediction** of detected nodules
- Provides **Lung-RADS** score

Efficiency



- Provides data on nodules within **1 minute***
- Provides nodule growth assessment with **longitudinal tracking**

Integration



- Allows **PACS integration**
- User friendly report

* May vary depending on the internet speed and server environment

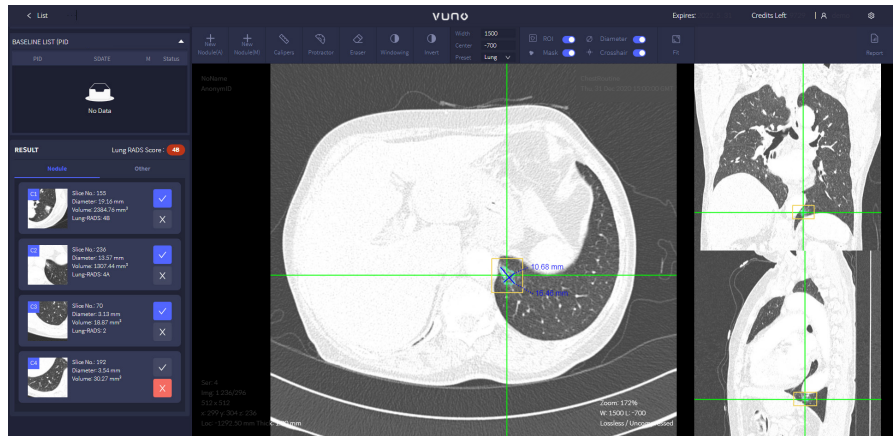
Performance Validation

Diagnostic Performance

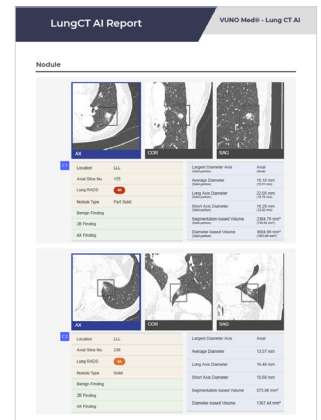
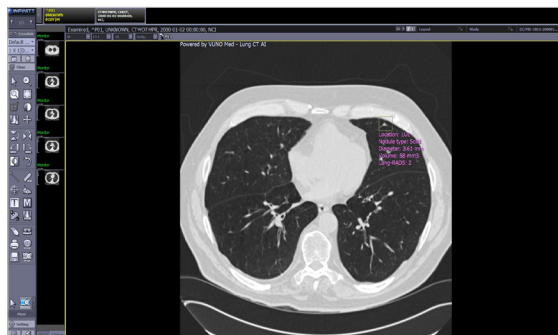


- VUNO Med-LungCT AI was trained on the CT images of about 2,000 patients
- High sensitivity with controlled false positive rate
- Preliminary studies demonstrated 100% and 97.3% sensitivity of pathologically confirmed malignant solid and ground-glass nodules, respectively¹

Product Screen



PACS Integration



Screening Performance

CT scans reported as normal (97%)



3%

Chest CT scans labeled as false negative by VUNO Med®-LungCT AI™

* All reference standards are based on the consensus of 3 radiologists

Screening Prowess

During a clinical study, 3% of CT scans were labelled as false negative by VUNO Med-LungCT AI in a group of 10,000 patients diagnosed as "normal". The clinical results were presented at journals and medical societies, including Radiological Society of North America (RSNA) and the Journal of Digital Imaging.²

Reference

- 1) Internal Validation 2017
- 2) Park H, et al., A Deep Learning-Based CAD that Can Reduce False Negative Reports: A Preliminary Study in Health Screening Center. Radiological Society of North America 2019 Scientific Assembly and Annual Meeting, December 1 - December 6, 2019, Chicago IL.



VUNO Med®

DeepBrain®

Introduction

Deep-learning based brain parcellation for the quantification of brain atrophy

VUNO Med®-DeepBrain® assists the diagnosis of neurodegenerative diseases by analyzing and quantifying brain volume information through brain parcellation. The degree of brain atrophy in a patient is evaluated through our deep learning algorithm and normative percentile values of the brain volumes are illustrated in comparison with that of the same age population.

Key Features

Clinical Support



Provides volumetric data of 104 brain regions through brain parcellation

- brain volume
- cortical thickness
- white matter hyperintensity (WMH)

Atrophy Analysis



- Compares patient's brain atrophy data with the normal population and displays as **normative percentile**

Efficiency



- Analysis of brain MR images within **1 minute***

* May vary depending on the internet speed and server environment

Performance Validation

VUNO Med -DeepBrain provides analysis results from brain parcellation within 1 minute



- Utilized MR images collected from more than 4000 patients across multiple leading medical institutions
- A high consistency of the volumetric data analysis of white matter hyperintensity (WMH) done by VUNO Med-DeepBrain is reported^{1,2}
 - Internal validation result : dice coefficient score 0.929¹
 - External validation result : dice coefficient score 0.948¹

Reference

1) Internal validation

2) WMH Segmentation Challenge Results MICCAI 2017

Product Screen



Brain Atrophy Report

VUNO Med-DeepBrain

VUNO Med-DeepBrain measures volumes of brain regions to provide a medical paradigm for the diagnosis and classification of dementia. To detect the a definitive diagnosis of dementia should be made when accompanied by additional examinations such as neurocognitive, neuropsychological, and neuropsychological testing.

PATIENT INFO	Product No.	Event Name	Date of Exam	Sex
Simulation Sample	ANONIMIZED	ANONIMIZED	2023-11-04	Male

Brain Age: **70 years-old**

Ranking of Brain Age: **98th**

Summary: Your brain age is 70 while your biological age is 60. Your rank is 98th out of a hundred healthy individuals of your age.

Volume by Brain Region (Percentage of ICB Normative Percentile)

The volumes of brain regions are corrected based on the intracranial volume and compared to the normative percentile values. An area is marked in red when its volume value is in the 95th percentile or below. An area is marked in blue when its volume value is in the 5th percentile or above. Brain atrophy measures the volume of the brain structures. A red-colored area indicates that its volume is in the 95th percentile or above.

Anonymous's Brain MRI

Region	Volume (%)	Normative Percentile
Frontal Lobe	42.3	<1.9
Temporal Lobe	14.9	<1.9
Parietal Lobe	4.6	<1.9
Occipital Lobe	84.3	>98.1
Lateral Ventricle	19.4	>98.1
Subcortical GM	13.8	>98.1
Caudate	16.1	>98.1
Frontal Lobe	32.7	<1.9
Temporal Lobe	14.8	<1.9
Parietal Lobe	16.9	<1.9
Occipital Lobe	77.9	>98.1
Lateral Ventricle	76.9	>98.1
Subcortical GM	37.4	>98.1
Hippocampus	14.8	<1.9
Caudate	5.9	<1.9

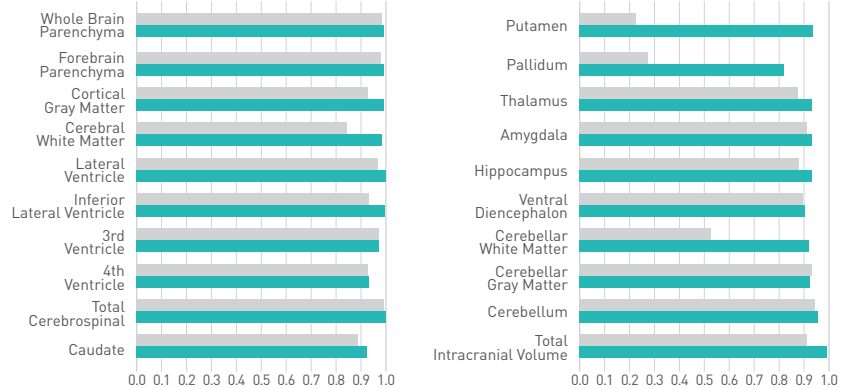
Volume by Brain Region

Legend: <1.9 (Red), <5 (Orange), <15 (Yellow), <30 (Green), >30 (Blue)

Brain Region	Volume (%)	Normative Percentile
Frontal Lobe	42.3	<1.9
Temporal Lobe	14.9	<1.9
Parietal Lobe	4.6	<1.9
Occipital Lobe	84.3	>98.1
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Subcortical GM	37.4	>98.1
Hippocampus	14.8	<1.9
Caudate	5.9	<1.9

- Includes:**
- Brain age & Ranking
 - Volume of brain regions corrected based on intracranial volume and compared to normative percentile values

Intra Correlation Coefficient (with FreeSurfer™)



VUNO Med-DeepBrain reported high consistency with FreeSurfer (reference standard) for almost all brain regions and this consistency is especially higher for small brain regions like putamen and pallidum³⁴

Reference

³⁾ Internal retrospective study

⁴⁾ Ochs AL, et al. Comparison of Automated Brain Volume Measures obtained with NeuroQuant and FreeSurfer. J Neuroimaging. 2015 Sep-Oct;25(5):721-7.

**FreeSurfer: A software package for the analysis and visualization of structural and functional neuroimaging data from cross-sectional or longitudinal studies.



VUNO Med®

BoneAge™

Introduction

Deep-learning based Automatic BoneAge Assessment

VUNO Med®-BoneAge™ is an innovative and cutting-edge software that was approved as Korea's first AI-based diagnostic software for bone age assessment. Based on hand X-ray images, VUNO Med-BoneAge provides an accurate bone age assessment by suggesting 3 nearest matching bone age results within seconds.

Key Features

Clinical Support



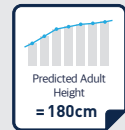
- Provides **bone age assessment** based on the 3 most likely candidates for bone age results, probability (%) and provides the AI based bone age

Efficiency



- Analysis of bone age within **5 ~ 10 secs**

Improvement



- Increases the **consistency and accuracy** of bone age assessments and boosts physician confidence in decision making
- Enhances the quality of **patient care** with comprehensive BoneAge Report

* May vary depending on the internet speed and server environment

Performance Validation

Comprehensive Data



Trained on large domestic data set consisting of pediatric images



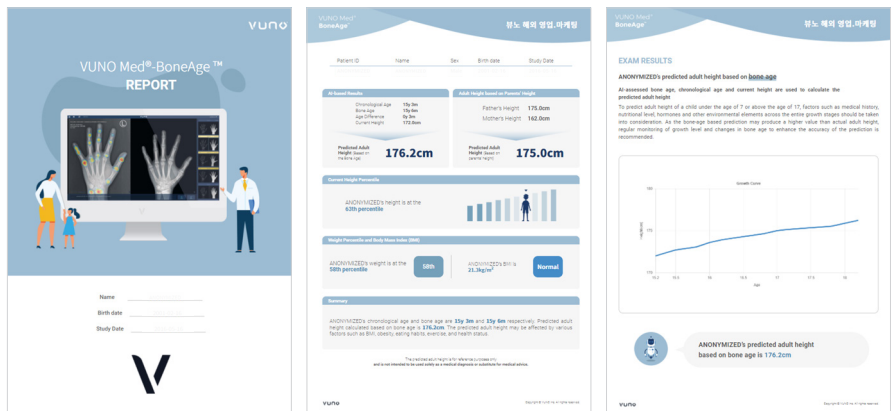
Enhanced with External data set consisting of pediatric images

Utilized more than 30,000 datasets collected from both Korean and Global pediatric patients to improve accuracy and consistency across race and reduce any risk of racial bias in the deep-learning AI algorithm

Product Screen



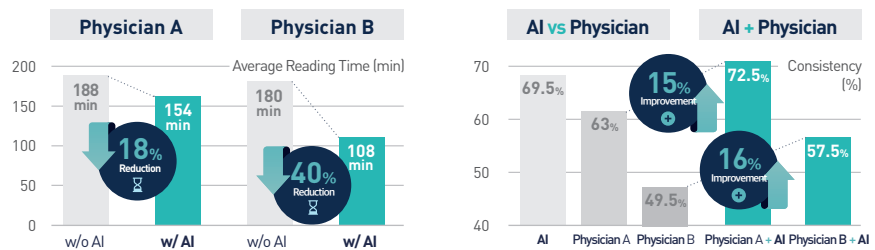
BoneAge Report



- Includes:
- Patient information with height percentile
 - BoneAge Assessment Results
 - Growth curve and adult height prediction

For better communication between patients and physicians, a comprehensive BoneAge Assessment Report is automatically generated and offered. This report improves quality of patient care – enhancing patient satisfaction and engagement.

Diagnostic Performance



VUNO Med-BoneAge helped reduce reading speed by approximately 40% and the diagnostic accuracy increased by 16%

200 Total Patients | Physician A : Subspecialized in pediatric radiology (experience reviewing 500 cases)
Physician B : Radiology 2nd Year Resident (Completed G.P. Atlas Training + experience reviewing 20 cases)

Reference

- 1) Internal Validation
- 2) Computerized Bone Age Estimation Using Deep Learning Based Program: Evaluation of the Accuracy and Efficiency, AJR Am J Roentgenol. 2017 Dec;209(6):1374-1380



VUNO Med®

Fundus AI™

Introduction

AI-based Screening Solution for Various Abnormalities in the Fundus

VUNO Med®-Fundus AI™ provides diagnostic support on common ocular disease based on detection of 12 retinal findings using deep learning algorithms. The AI-based detection of fundus abnormalities provides an immediate, accurate interpretation of fundus images to support the diagnosis of a broad range of ocular disease.

Key Features

Clinical Support



- Detection of **12 retinal findings** associated with diagnosis of vision-threatening ocular disease (AMD, DR, Glaucoma, RVO)

Accuracy



- High sensitivity and specificity with AUROC **96.2–99.9%¹**

Efficiency



- Immediate fundus interpretation in only **2 seconds**

Automatic Detection of 12 Retinal Findings

- Hemorrhage
- Hard Exudate
- Cotton Wool Patch
- Drusen
- Membrane
- Macular Hole
- Myelinated Nerve Fiber
- Chorioretinal Atrophy
- Vascular Abnormality
- Retinal Nerve Fiber Layer Defect
- Glaucomatous Disc Change
- Non-glaucomatous Disc Change

Performance Validation

Comprehensive training, testing and validation

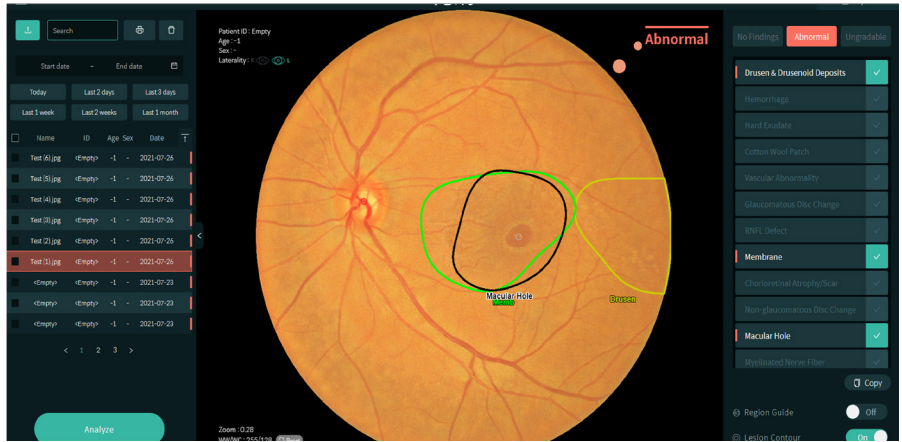
Developed and validated with 100,000+ images graded by 57 ophthalmologists of different sub-specialities¹

Consistent and stable performance on internal test set¹ (AUROC 96.2 – 99.9%)

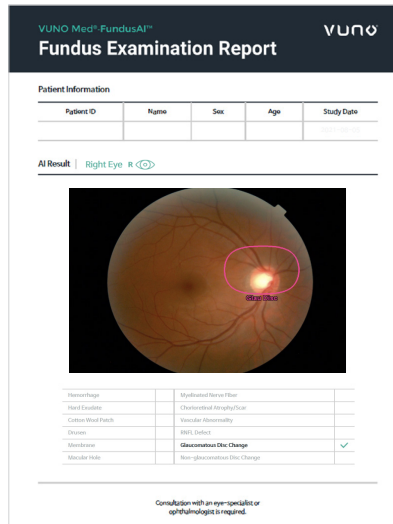
Consistent and stable performance on external test set

(France and India)¹ (AUROC 94.7 – 98.0%)

Product Screen



Fundus Examination Report

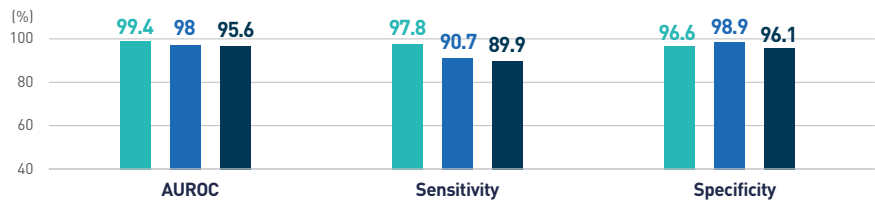


- Includes:
- Patient information
 - Fundus image with detected abnormalities

Diagnostic Performance

- Hospital A (In-House test, Korea)
- Hospital B (External test, India)
- Hospital C (External test, France)

Performance Comparison (Hemorrhage case)



Reference

1) Son J, et al. Development and Validation of Deep Learning Models for Screening Multiple Abnormal Findings in Retinal Fundus Images. Ophthalmology (2019).

VUNO Med[®] Solutions

– Installation Options

On-premise

- A physical, on-site server where **VUNO Med[®] solutions** are installed and run within a client's in-house infrastructure
- **VUNO Med[®] solutions** can be used on a license / subscription basis or pay-per-scan basis



Cloud

- A virtual server where **VUNO Med[®] solutions** are installed and customers can access solution by logging on to the server (URL) to use our products
- **VUNO Med[®] solutions** can be used on a license / subscription basis or pay-per-scan basis



On Device

- **VUNO Med® solutions** are embedded in diagnostic modalities through the SDK integration such as an X-ray, CT, MRI scanner or fundus camera
- **VUNO Med® solutions** can be used as a bundled product in diagnostic modality



PACS Integration

- **VUNO Med® solutions** can be integrated in the PACS/EMR system as a secondary feature
- **VUNO Med® solutions** can be used as a bundled product with PACS

VUNO®

VUNO® Reg. KIPO, U.S. PTO & EUIPO

VUNOMed® Reg. KIPO, & U.S. PTO

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