Wellstar

LUNG CANCER SCREENING AND INCIDENTALS

Taking it to the next level:

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Chief Medical Officer – Oncology
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The Sybil Consortium
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IS THERE A ROLE FOR ARTIFICIAL INTELLIGENCE?

DISCLOSURES

MEDTRONIC ROBOTICS ADVISORY BOARD
ASTRA ZENECA SPEAKERS BUREAU

i3 Health and FLASCO have mitigated all relevant financial relationships

EARLY DETECTION

What are we trying to do?

Assess Risk to Detect Early Cancers

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ARTIFICIAL INTELLIGENCE

CONVERT DATA → INTO INSIGHTS → INTO ACTION

EARLY DETECTION

Can Artificial Intelligence disrupt current methodology?

YES, WITH CAVEATS....

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AI HELPS ASSESS RISK FOR LUNG CANCER

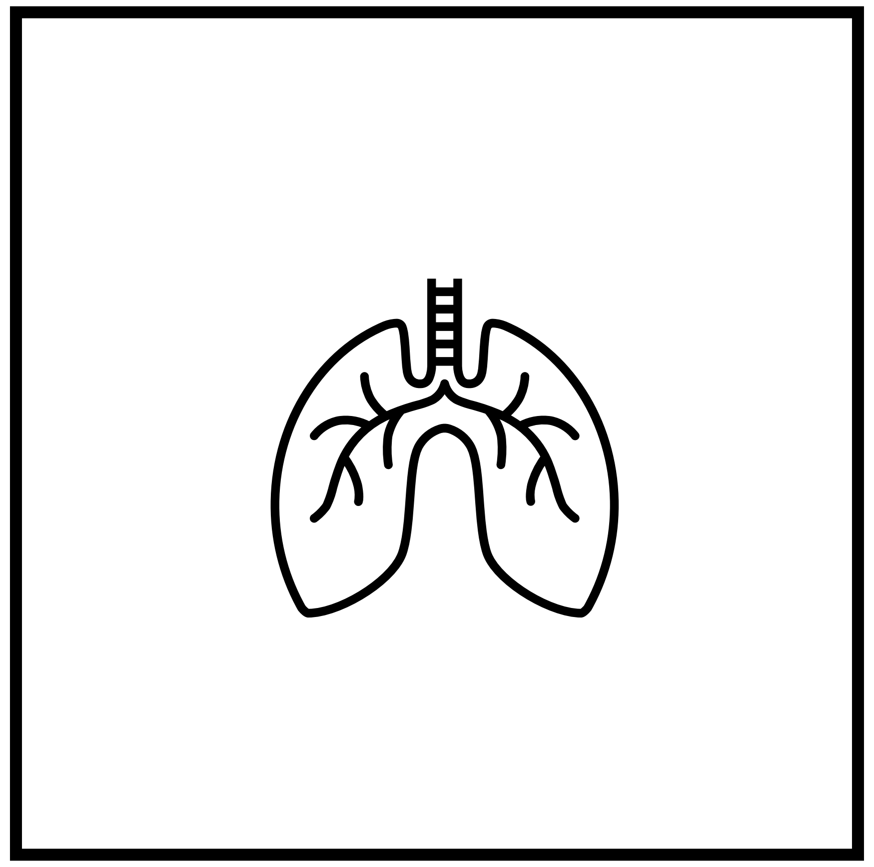
1. IDENTIFY RISK
2. STRATIFY RISK
3. ANALYZE RISK
4. MITIGATE RISK

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

IDENTIFY RISK

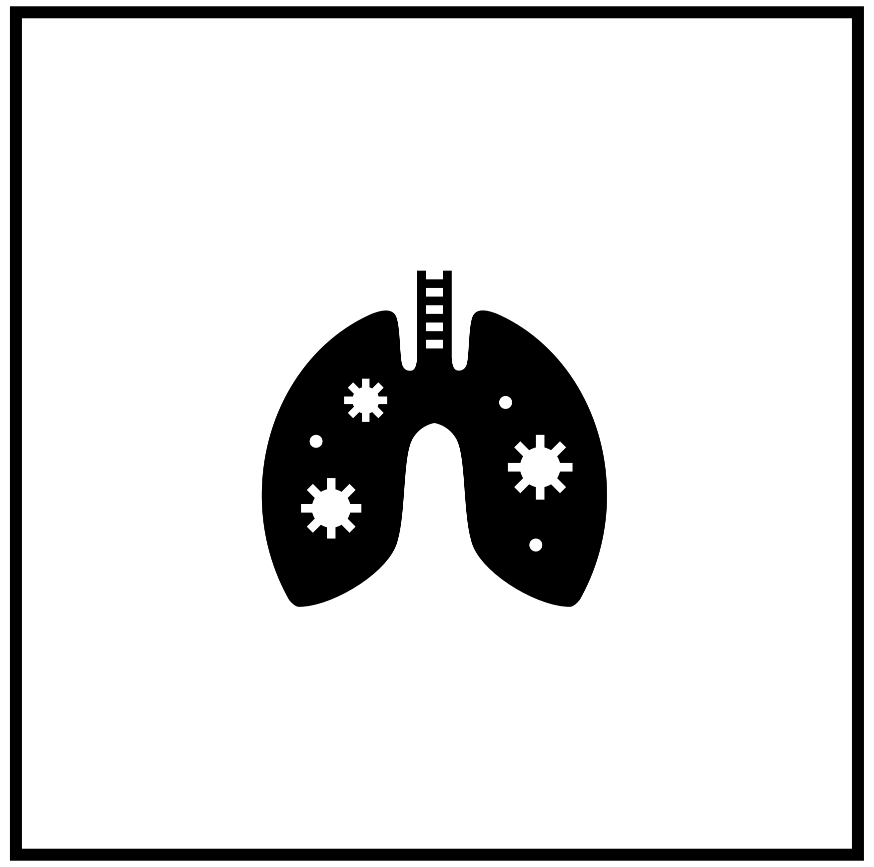
DATA MINING AND NODULE IDENTIFICATION

CLINICAL RISK PREDICTORS ARE LIMITED AND LABORIOUS



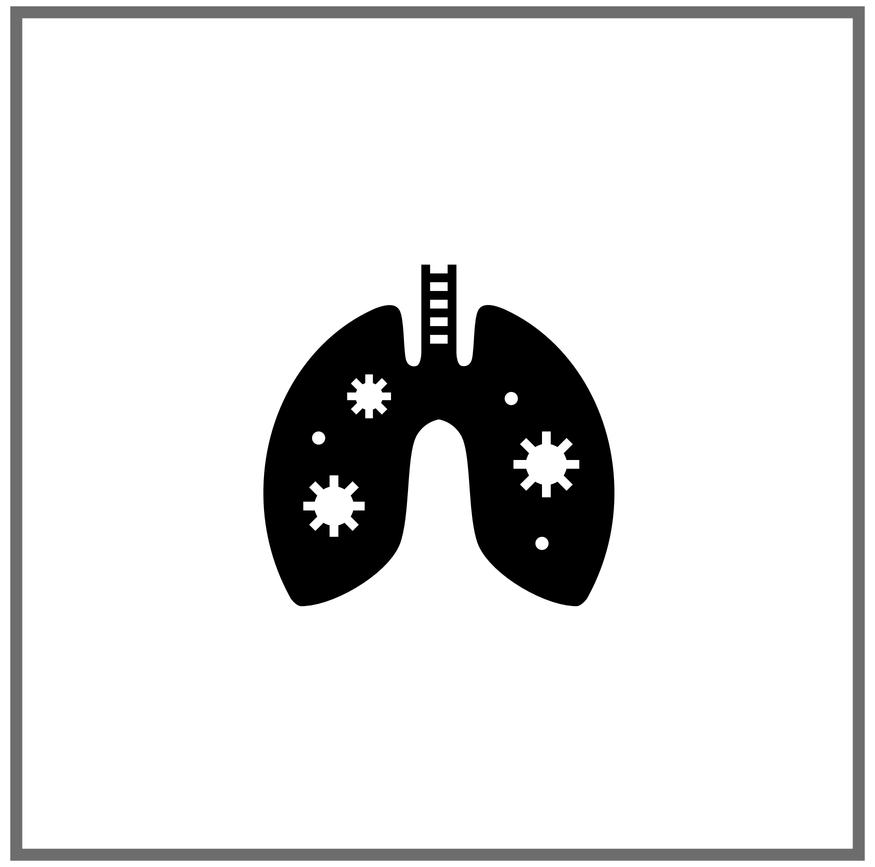
PLCO M2012

SOCIODEMOGRAPHIC, MEDICAL HISTORY, FOUR SMOKING VARIABLES, AGE, FAMILY HISTORY, ETC.



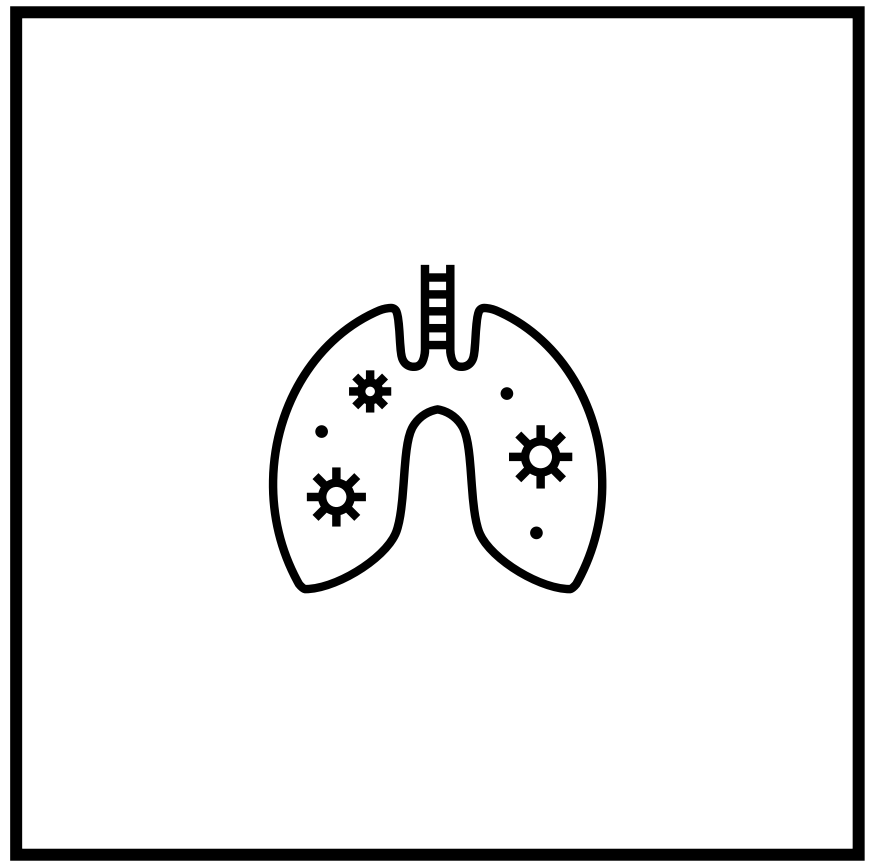
BROCK, MAYO

REQUIRES SIGNIFICANT CLINICAL DATA



LUNG RADS

REQUIRES NODULE: CHARACTERISTICS, SIZE, CHANGE



FLESCHNER'S

REQUIRES NODULE: CHARACTERISTICS, SIZE, CHANGE

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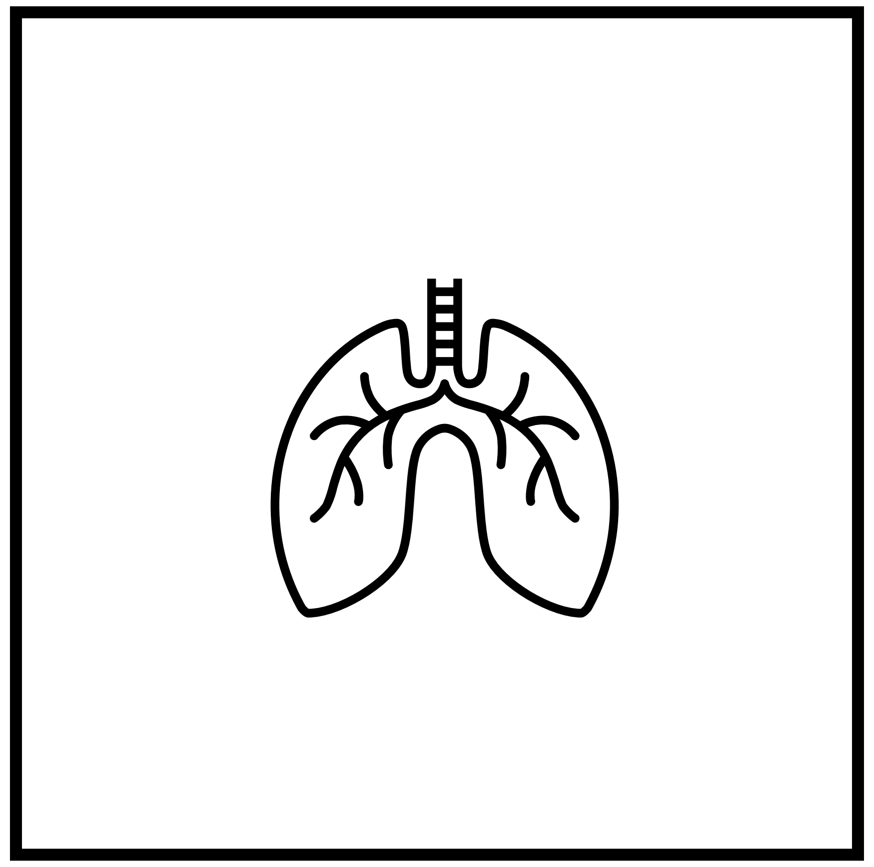
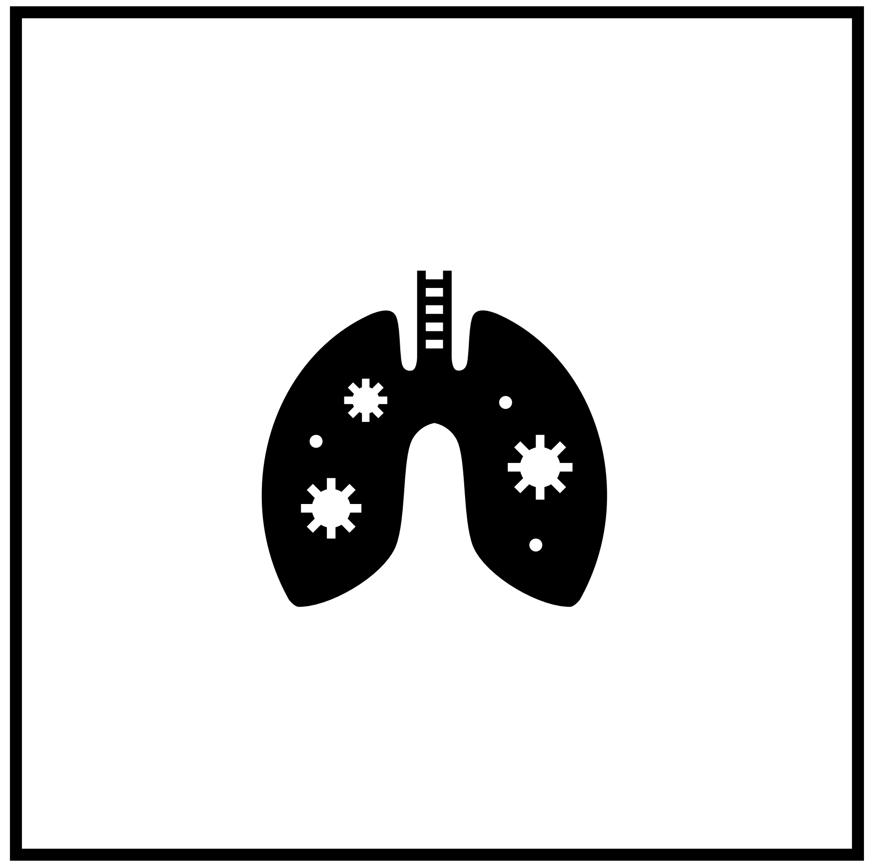
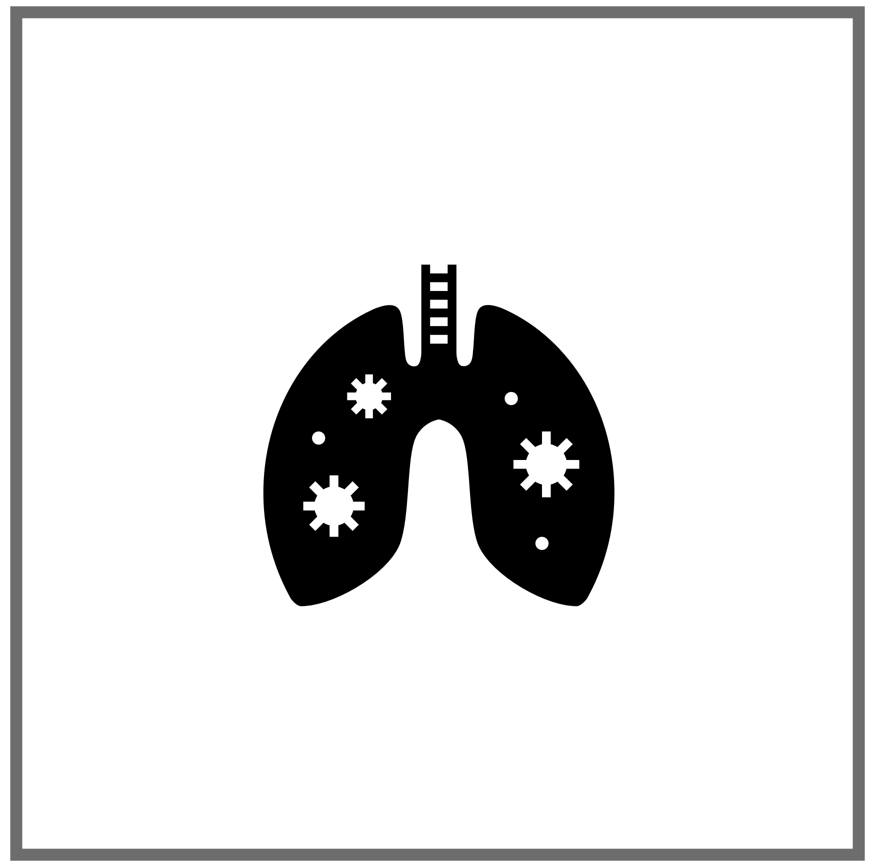
ARTIFICIAL INTELLIGENCE IDENTIFIES THOSE AT RISK



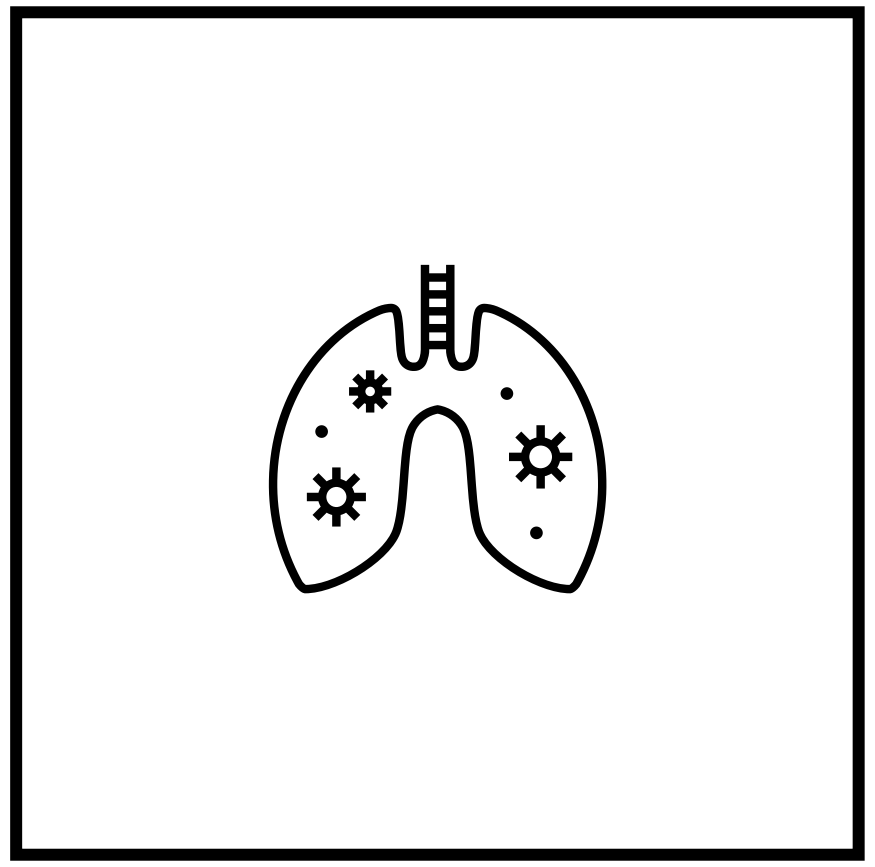
EMR
DATA MINING



CT REPORT
DATA MINING



COMPUTER
ASSISTED
NODULE DETECTION



PATHWAY
SUGGESTION

IMPROVES RECRUITMENT FOR EARLY DETECTION

ARTIFICIAL INTELLIGENCE IDENTIFIES THOSE AT RISK

THE LANCET
Oncology

REVIEW · Volume 25, Issue 12, E694-E703, December 2024

Artificial intelligence-aided data mining of medical records for cancer detection and screening

Amalie Dahl Haue, MD PhD [a,b] · Jessica Xin Hjaltelin, PhD [a] · Peter Christoffer Holm, PhD [a] · Davide Placido, PhD [a,b] · S∅ren Brunak, PhD [a,b]

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In summary, the application of AI to multimodal, population-wide, health data brings the possibility of an array of methods for the mapping of malignant phenotypic spectra to a risk continuum. Therefore, avenues for developing cancer screening and early detection methods are wider than ever. The access to population-wide electronic health record data is an opportunity for predictive AI models to generalise to a much larger part of the heterogeneous phenotypic space of patients with cancer, and importantly, differentiate these patients from healthy controls that are also highly heterogeneous. Time will

IMPROVES RISK ASSESSMENT FOR EARLY DETECTION

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ARTIFICIAL INTELLIGENCE IDENTIFIES THOSE AT RISK

JACC: ADVANCES

VIEWPOINT

Population Health and Artificial Intelligence

R. Kannan Mutharasan, MD, MBA,[a] Jessica Walradt, MS[b]

Radiology: Artificial Intelligence

ORIGINAL RESEARCH

Assistive AI in Lung Cancer Screening: A Retrospective Multinational Study in the United States and Japan

Atilla P. Kiraly, PhD • Corbin A. Cunningham, PhD • Ryan Najafi, PhD • Zaid Nabulsi, MS • Jie Yang, PhD • Charles Lau, MD, MBA • Joseph R. Ledsam, MD • Wenxing Ye, PhD • Diego Ardila, MS • Scott M. McKinney, MS • Rory Pilgrim, BEng • Yun Liu, PhD • Hiroaki Saito, MD • Yasuteru Shimamura, MD • Mozziyar Etemadi, PhD, MD • David Melnick, MS • Sunny Jansen, PhD • Greg S. Corrado, PhD • Lily Peng, PhD, MD • Daniel Tse, MD • Shravya Shetty, MS • Shruthi Prabhakara, PhD • David P. Naidich, MD • Neeral Beladia, MS • Krish Eswaran, PhD

From Google Health Research, 1600 Amphitheatre Pkwy, Mountain View, CA 94043 (A.P.K., C.A.C., R.N., Z.N., C.L., J.R.L., D.A., S.M.M., R.P., Y.L., S.J., G.S.C., L.P., D.T., S.S., S.P., K.E.); Waymo, Mountain View, Calif (J.Y., N.B.), David Geffen School of Medicine at UCLA, Los Angeles, Calif (C.L.); Google, Mountain View, Calif (W.Y.); Department of Gastroenterology, Sendai Kousei Hospital, Sendai, Japan (H.S.); MNES Inc, Hiroshima, Japan (Y.S.); Department of Telemedicine, Northwestern University Feinberg School of Medicine, Chicago, Ill (M.E., D.M.); and Center for Biological Imaging, New York University–Langone Medical Center, New York, NY (D.P.N.). Received March 23, 2023; revision requested May 22; revision received January 7, 2024; accepted March 1. **Address correspondence to** A.P.K. (email: *akiraly@google.com*).

Supported by Google.

Conflicts of interest are listed at the end of this article.

Radiology: Artificial Intelligence 2024; 6(3):e230079 • https://doi.org/10.1148/ryai.230079 • Content codes: AI OI CH

IMPROVES RECRUITMENT FOR EARLY DETECTION

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

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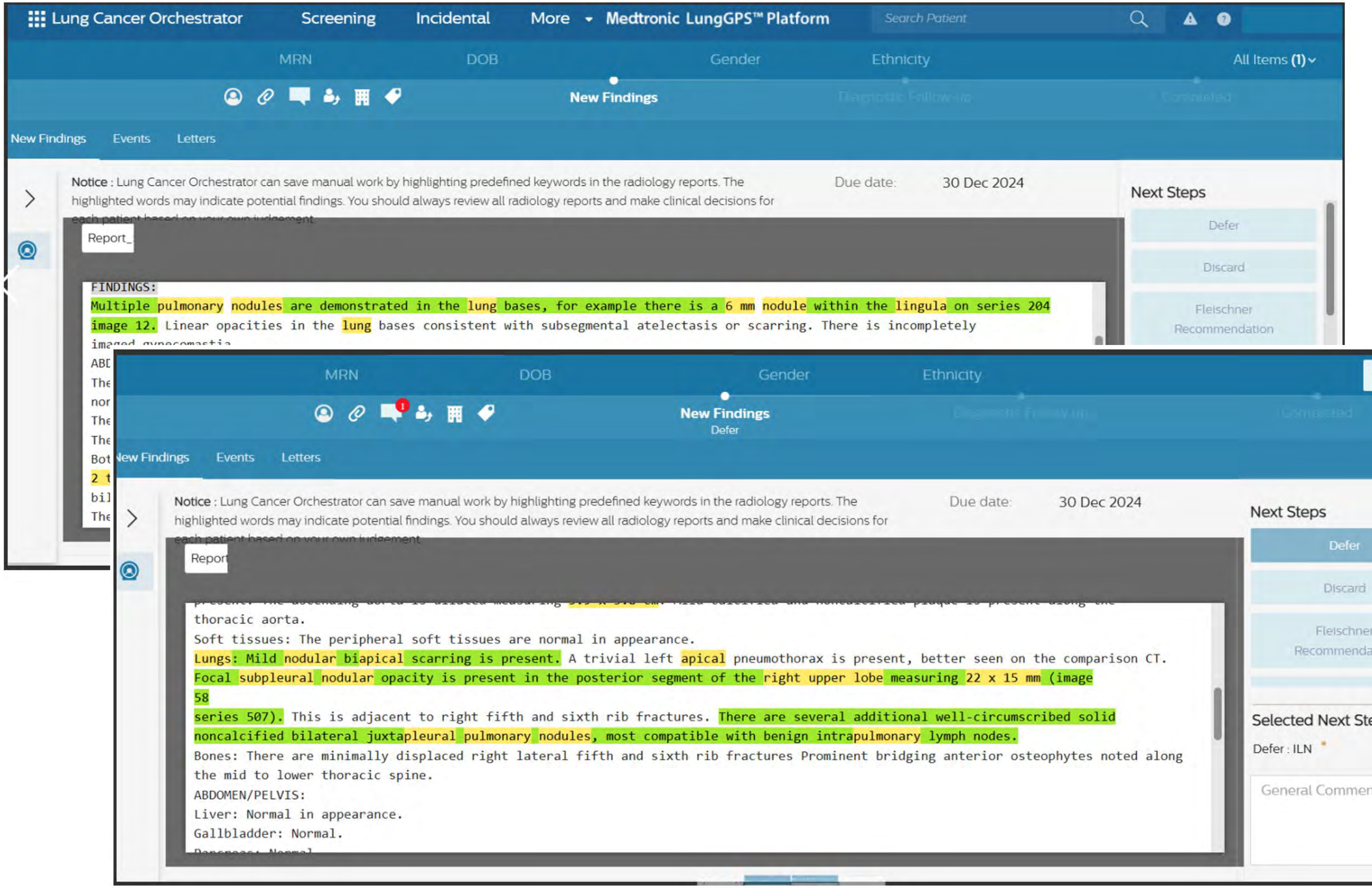
WELLSTAR LCO: DATA MINING

NLP SCANS CT REPORTS FOR PRE-SELECTED TERMS AND PHRASES

OUR TEAM REVIEWS REPORTS FOR APPROPRIATE REFERRAL

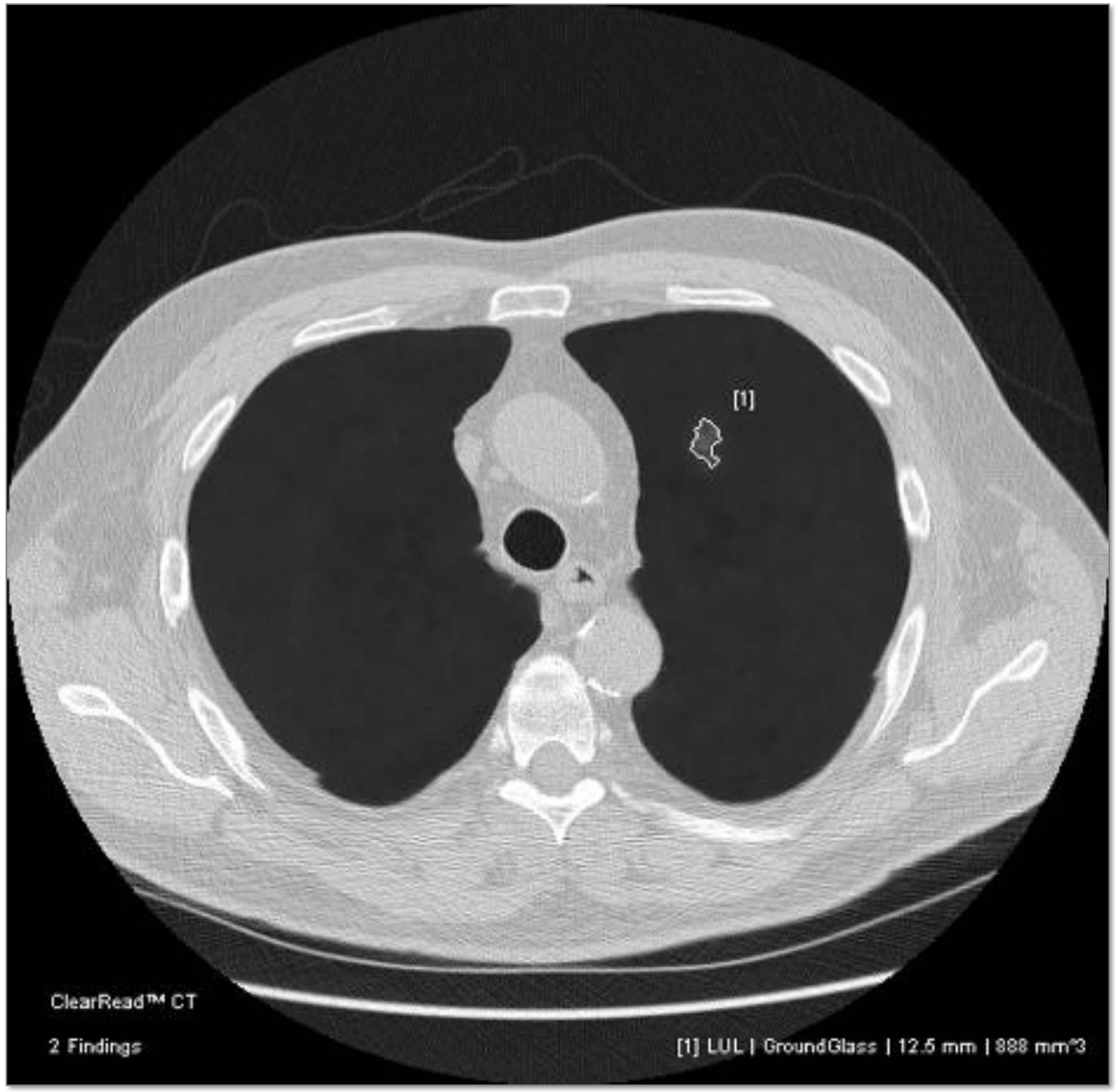
IDENTIFIES PATIENTS AT RISK BY TERMINOLOGY



RIVERAIN

NODULE DETECTION
FDA APPROVED

AI REMOVES VASCULATURE TO REVEAL NODULES

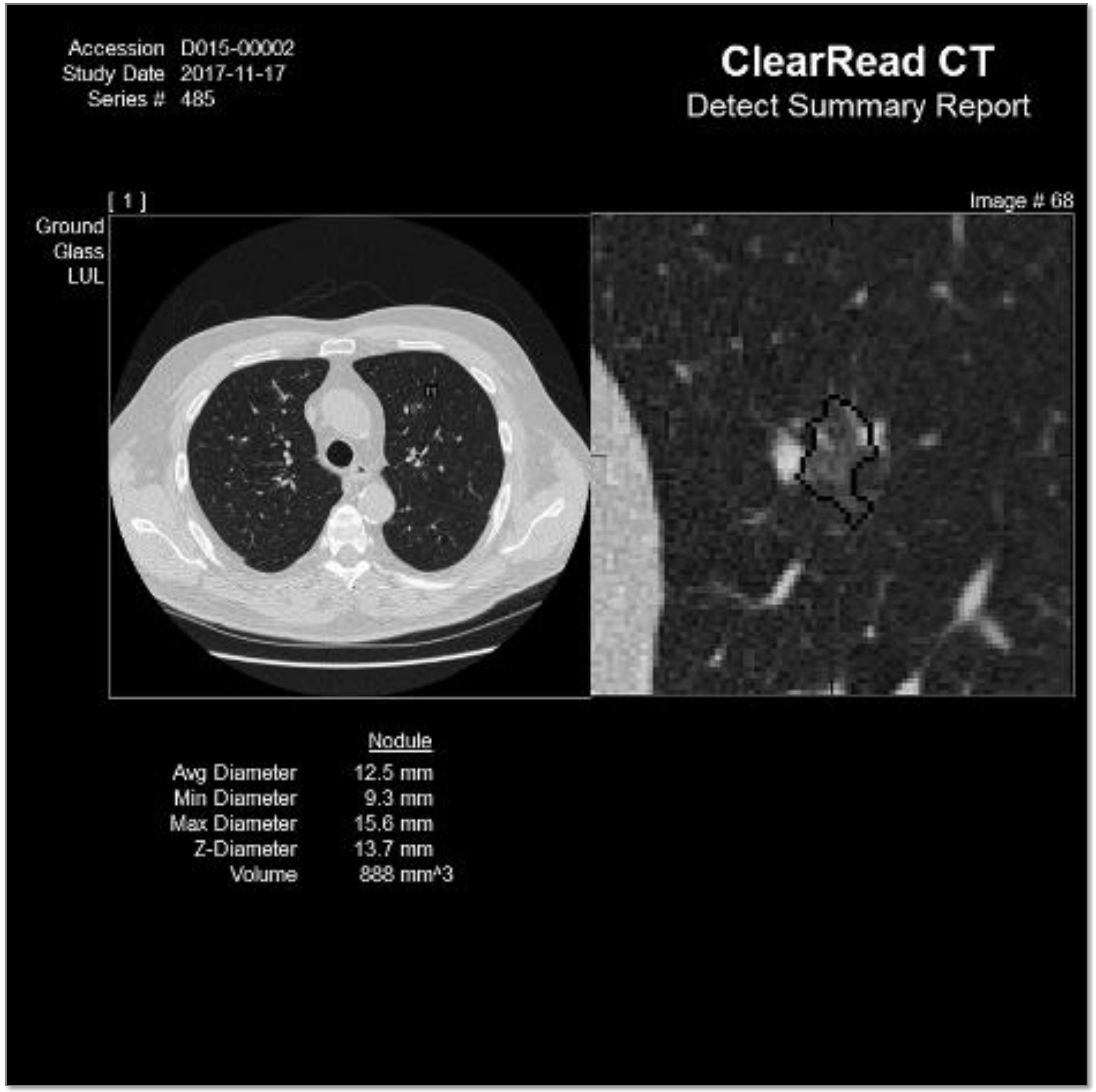


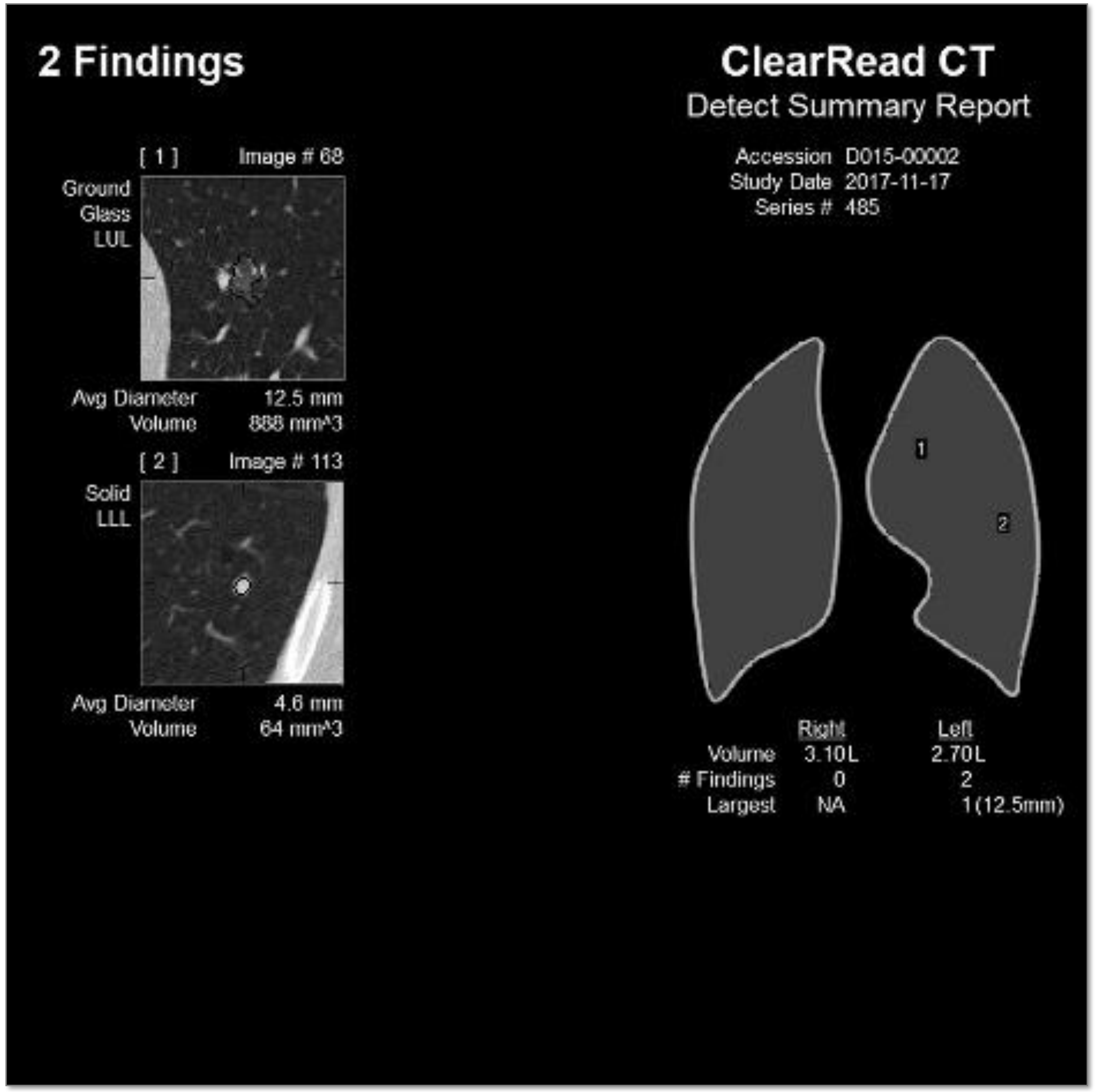
RIVERAIN

NODULE DETECTION REPORT CREATION

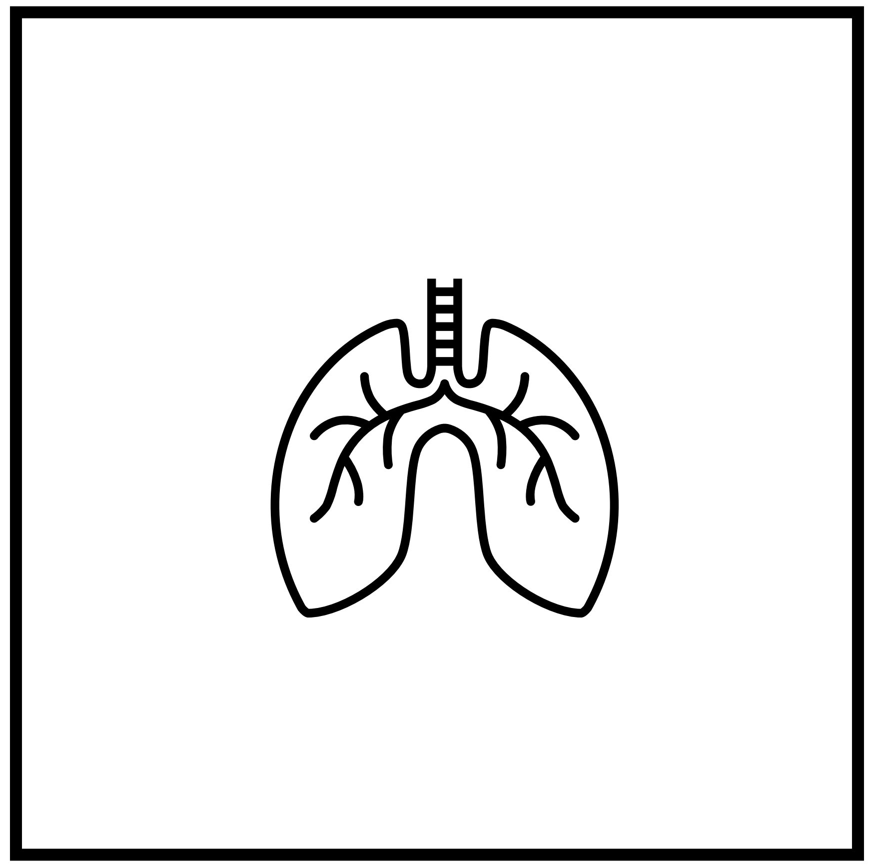
AI CREATES A **SUMMARY REPORT**

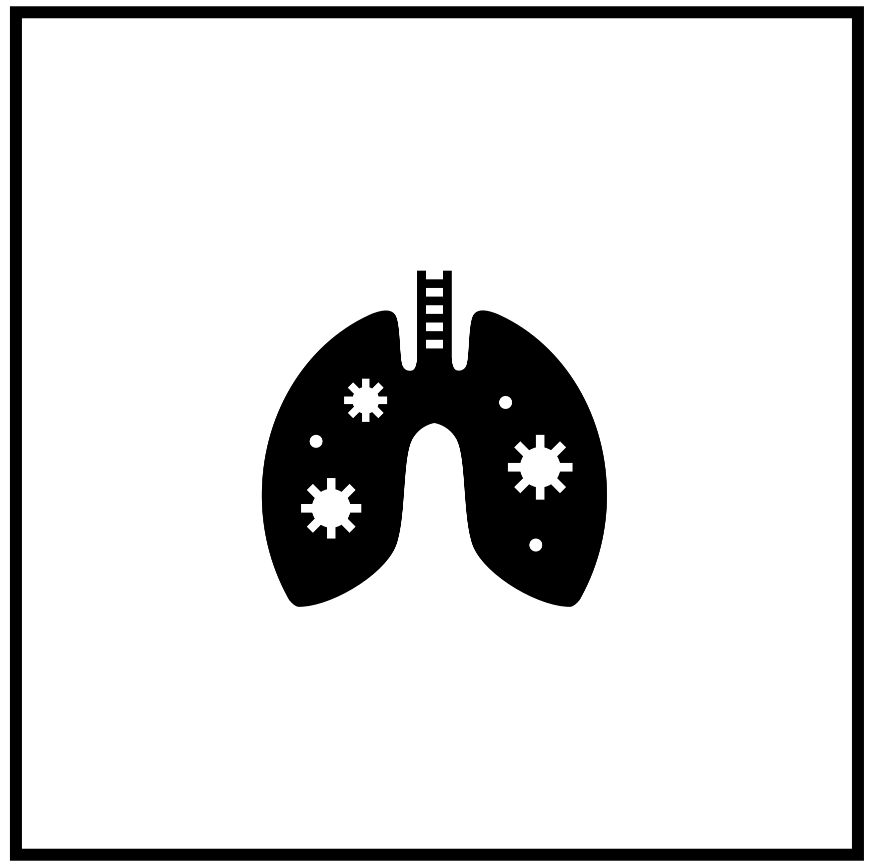
INSERTS INTO POWERSCRIBE

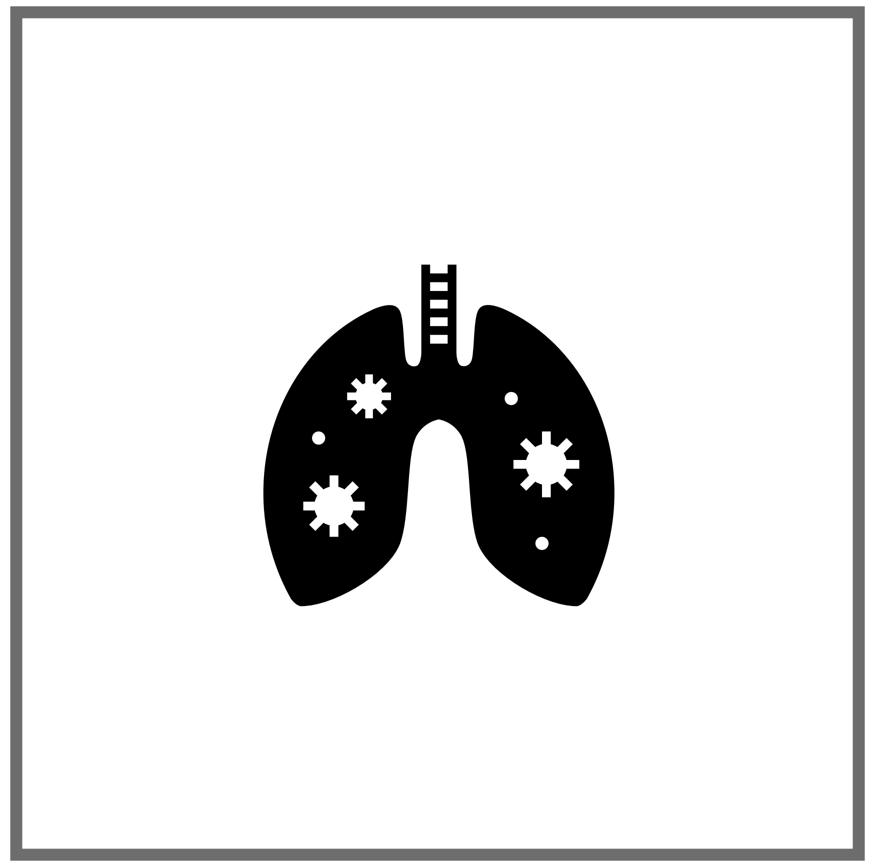


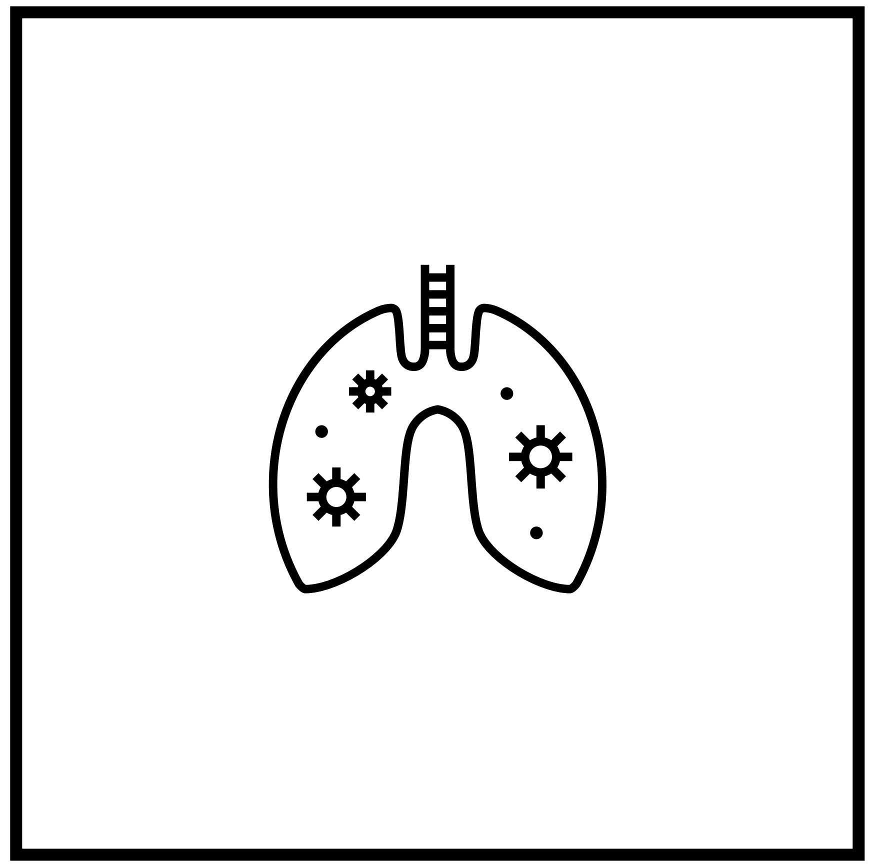


ARTIFICAL INTELLIGENCE: IDENTIFY









AZRA AI

AI INTERPRETS
UNSTRUCTURED DATA

.

EON
AZRA AI

READS CT SCAN REPORTS
IDENTIFIES RISK CRITERIA

LUNG CANCER
ORCHESTRATOR

SCANS LDCT REPORTS
FOR KEY WORDS AND
PHRASES

RIVERAIN

NODULE DETECTION
CREATES NODULE
TABLE,

LOOK-BACK

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

STRATIFY RISK

SEPARATE LOW RISK FROM HIGH RISK

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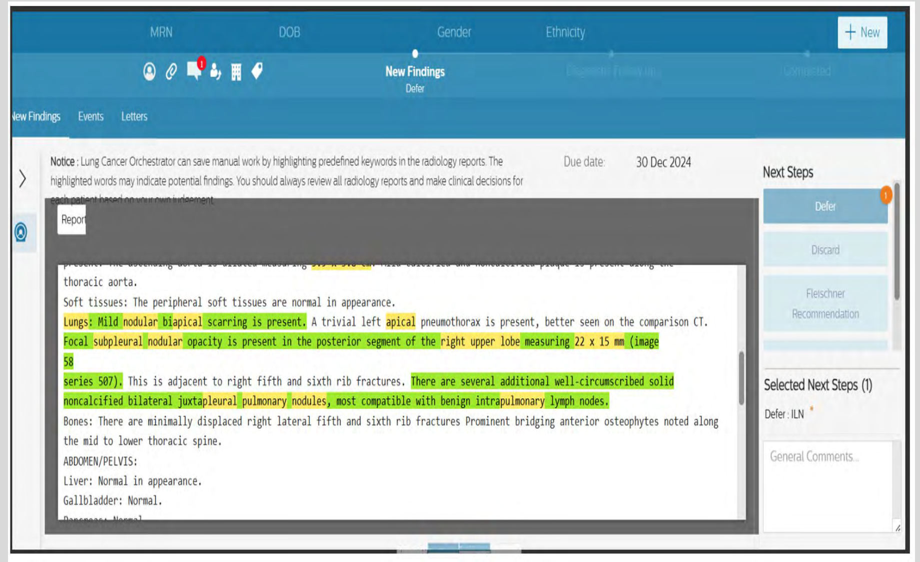
EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

STRATIFY RISK

SEPARATE HIGHER RISK FROM LOWER RISK .



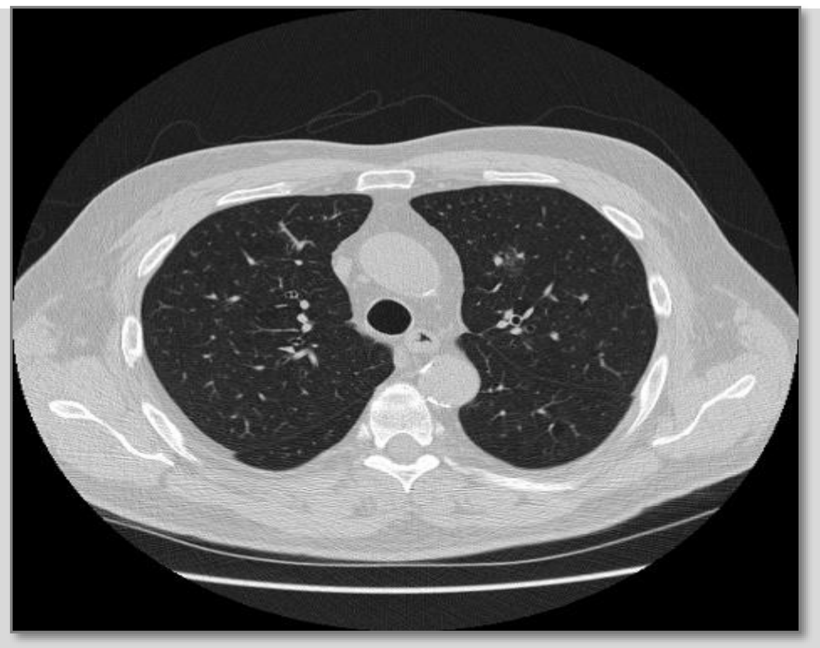
BY CLINICAL FACTORS

AI STRATIFIES DATA MINING RESULTS

IDENTIFY THOSE AT HIGHER RISK

BY TERMINOLOGY

NODULES DESCRIBED OVER 8 MM ARE PRIORITIZED



BY NODULE SIZE ON CT

NODULE TABLE SORTS NODULES BY SIZE

BY NODULE CHARACTER

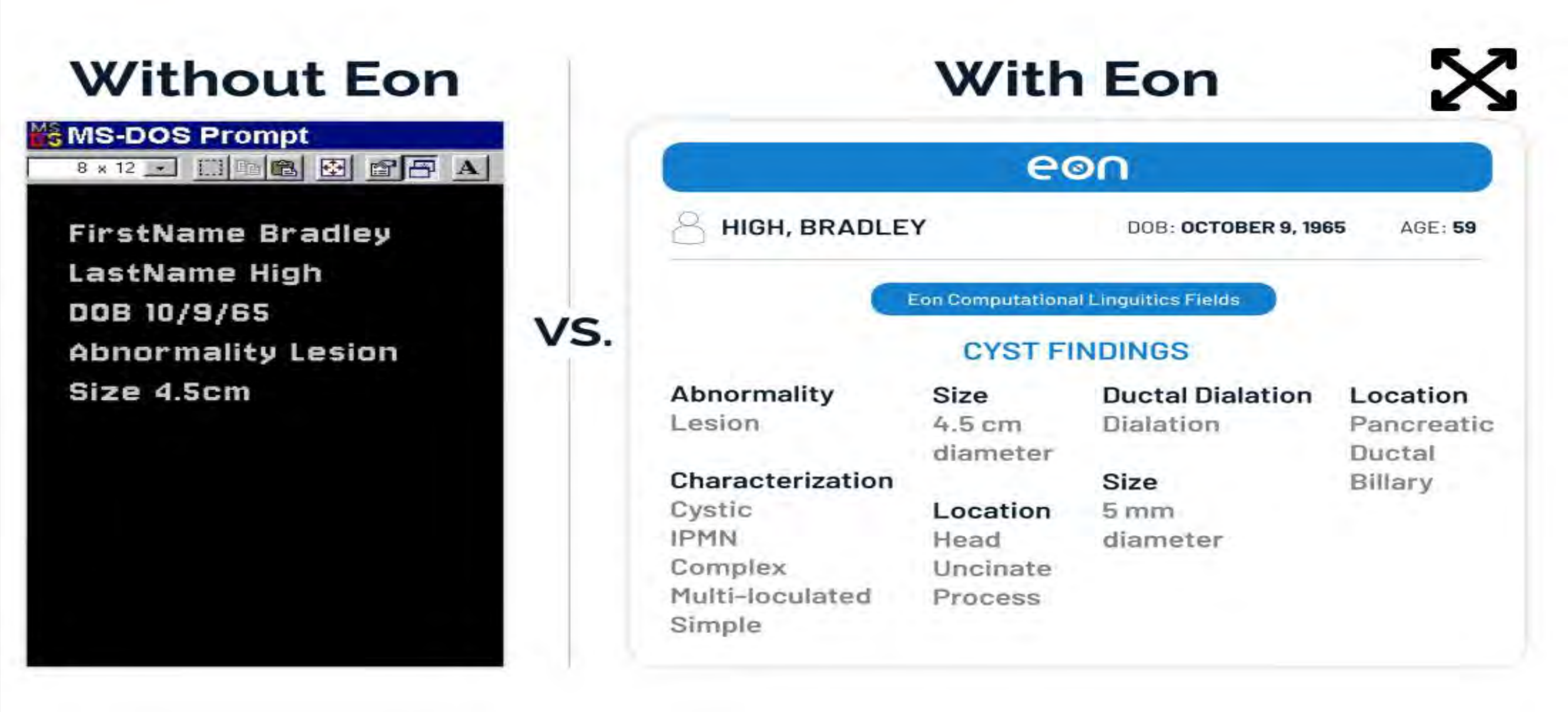
BORDER ANALYSIS, SOLID, SEMI-SOLID, GGO, GROWTH

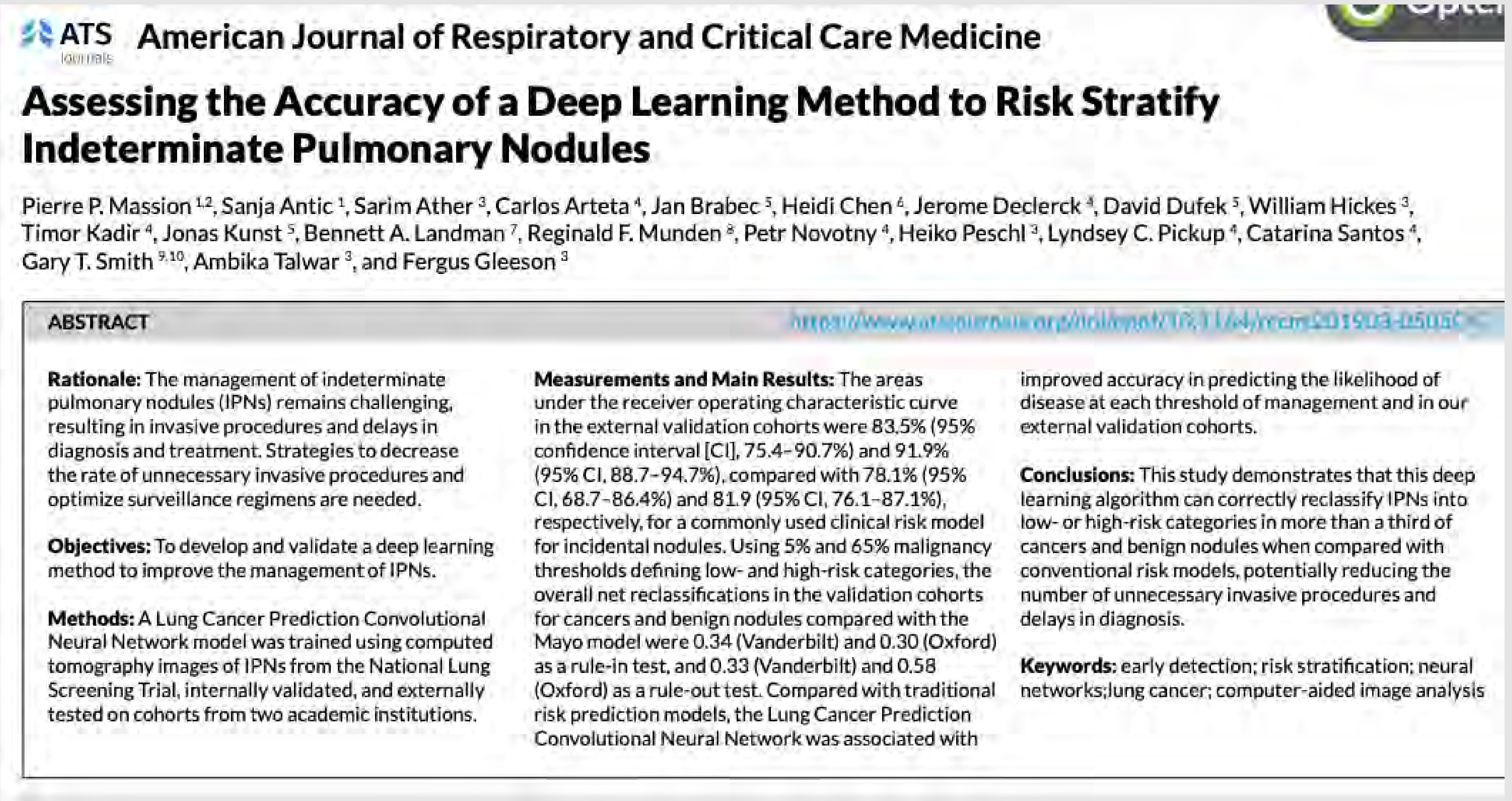
EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

STRATIFY RISK

SEPARATE HIGHER RISK FROM LOWER RISK .

EON




ATS Journals American Journal of Respiratory and Critical Care Medicine

Assessing the Accuracy of a Deep Learning Method to Risk Stratify Indeterminate Pulmonary Nodules

Pierre P. Massion [1,2], Sanja Antic [1], Sarim Ather [3], Carlos Arteta [4], Jan Brabec [5], Heidi Chen [6], Jerome Declerck [4], David Dufek [5], William Hickes [3], Timor Kadir [4], Jonas Kunst [5], Bennett A. Landman [7], Reginald F. Munden [8], Petr Novotny [4], Heiko Peschl [3], Lyndsey C. Pickup [4], Catarina Santos [4], Gary T. Smith [9,10], Ambika Talwar [3], and Fergus Gleeson [3]

ABSTRACT

Rationale: The management of indeterminate pulmonary nodules (IPNs) remains challenging, resulting in invasive procedures and delays in diagnosis and treatment. Strategies to decrease the rate of unnecessary invasive procedures and optimize surveillance regimens are needed.

Objectives: To develop and validate a deep learning method to improve the management of IPNs.

Methods: A Lung Cancer Prediction Convolutional Neural Network model was trained using computed tomography images of IPNs from the National Lung Screening Trial, internally validated, and externally tested on cohorts from two academic institutions.

Measurements and Main Results: The areas under the receiver operating characteristic curve in the external validation cohorts were 83.5% (95% confidence interval [CI], 75.4–90.7%) and 91.9% (95% CI, 88.7–94.7%), compared with 78.1% (95% CI, 68.7–86.4%) and 81.9 (95% CI, 76.1–87.1%), respectively, for a commonly used clinical risk model for incidental nodules. Using 5% and 65% malignancy thresholds defining low- and high-risk categories, the overall net reclassifications in the validation cohorts for cancers and benign nodules compared with the Mayo model were 0.34 (Vanderbilt) and 0.30 (Oxford) as a rule-in test, and 0.33 (Vanderbilt) and 0.58 (Oxford) as a rule-out test. Compared with traditional risk prediction models, the Lung Cancer Prediction Convolutional Neural Network was associated with improved accuracy in predicting the likelihood of disease at each threshold of management and in our external validation cohorts.

Conclusions: This study demonstrates that this deep learning algorithm can correctly reclassify IPNs into low- or high-risk categories in more than a third of cancers and benign nodules when compared with conventional risk models, potentially reducing the number of unnecessary invasive procedures and delays in diagnosis.

Keywords: early detection; risk stratification; neural networks;lung cancer; computer-aided image analysis

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

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STRATIFY RISK

SEPARATE HIGHER RISK FROM LOWER RISK .

WELLSTAR LCO

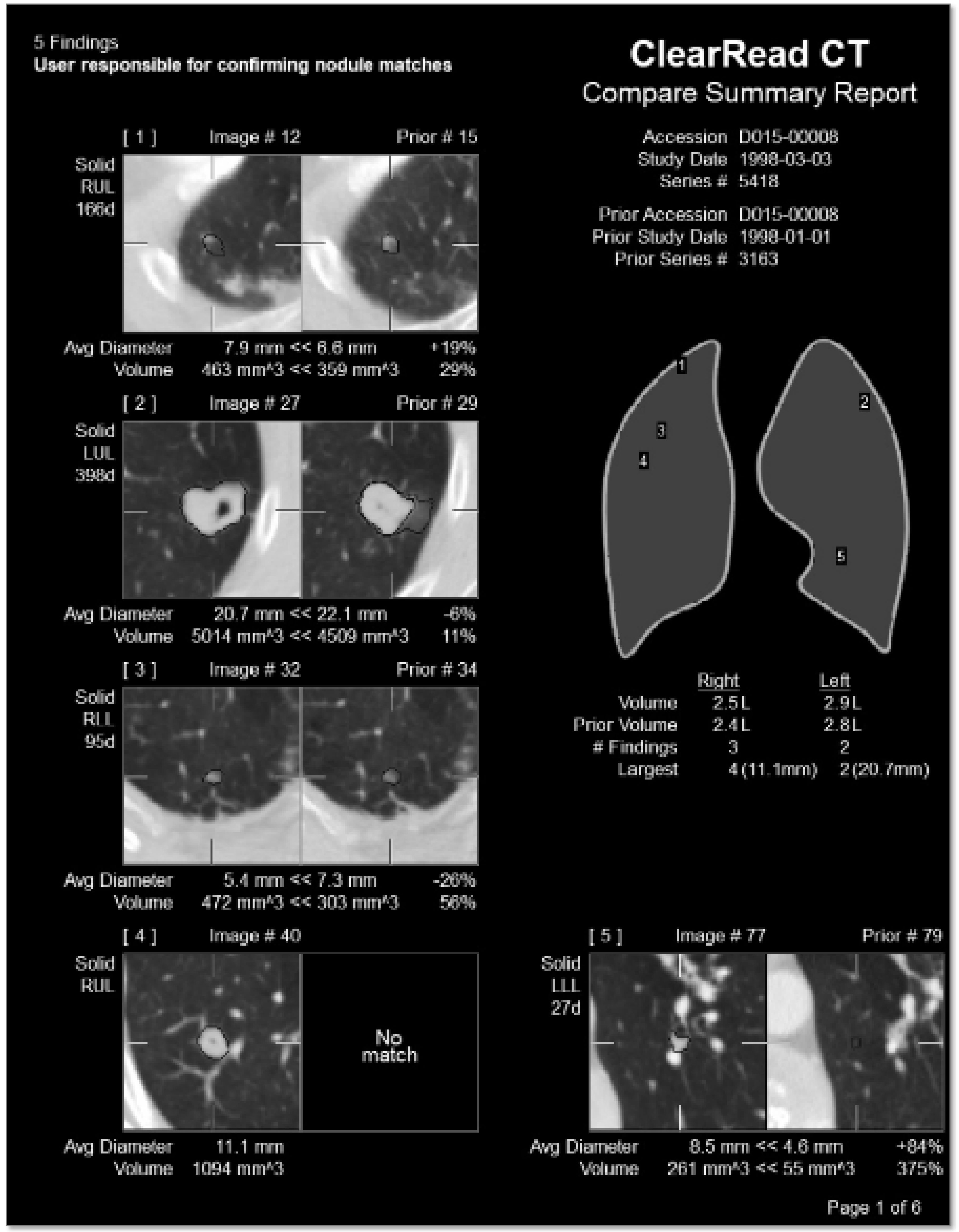
Nodule size is listed in LCO worklist which helps the coordinators prioritize working their patients.

Name	MRN	Gender	Age	Creation Date	Status	Sub-status	Defer/Discard Reason	Unreviewed report	Due date	Notes	Assignee	Managed By Facility	Tags	Actions
		Male	42	05 Oct 2024	New Findings			0	15 Oct 2024			WellstarMF_KH	1-2 mm	
		Male	40	05 Oct 2024	New Findings			0	15 Oct 2024			WellstarMF_KH	7 x 5 mm	
		Female	89	05 Oct 2024	New Findings			0	15 Oct 2024			WellstarMF_NF	4 mm	
		Female	65	06 Oct 2024	New Findings			1	16 Oct 2024			WellstarMF_DH		
		Female	83	06 Oct 2024	New Findings			0	16 Oct 2024			SP		

RIVERAIN

STRATIFY RISK

Automatic nodule comparison from current and prior exam



EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

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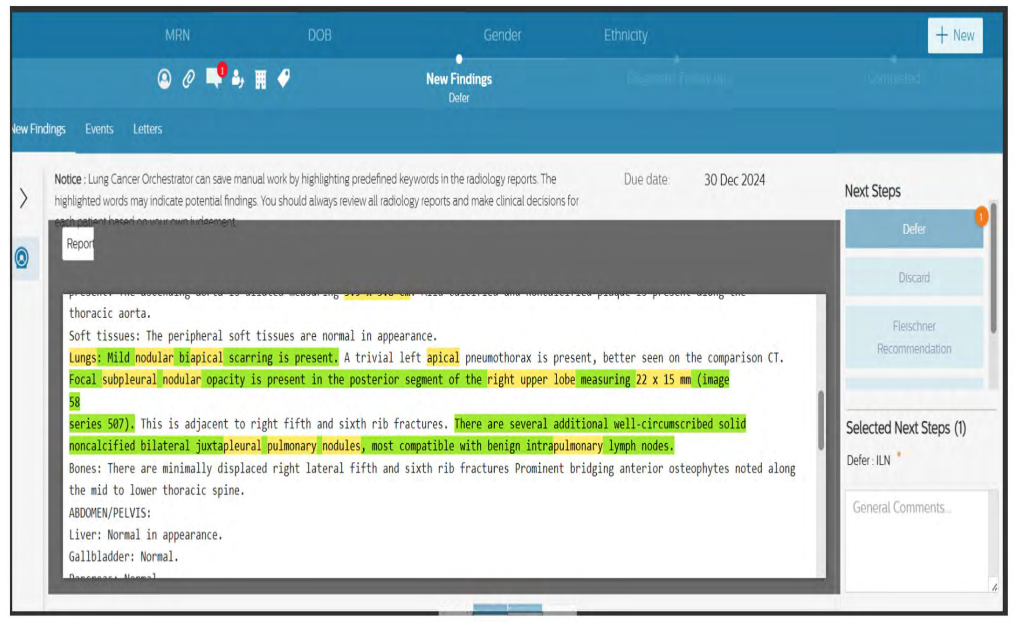
STRATIFY RISK

SEPARATE HIGHER RISK FROM LOWER RISK .



BY CLINICAL FACTORS

AZRA AI

EON

LUNG CANCER ORCHESTRATOR

BY NODULE SIZE

EON

LUNG CANCER ORCHESTRATOR

BY TERMINOLOGY

AZRA AI

EON

LUNG CANCER ORCHESTRATOR

BY NODULE CHARACTER

GGO, NON-SOLID, SOLID,

SPICULATED

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

ANALYZE RISK

WHO SHOULD GET A WORKUP

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EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

NODULE ANALYSIS BY AI

OPTELLUM

FDA APPROVED

BMJ Journals Thorax

External validation of a convolutional neural network artificial intelligence tool to predict malignancy in pulmonary nodules

David R Baldwin,[1] Jennifer Gustafson,[2] Lyndsey Pickup,[3] Carlos Arteta,[3] Petr Novotny,[4] Jerome Declerck,[3] Timor Kadir,[3] Catarina Figueiras,[2] Albert Sterba,[5] Alan Exell,[6] Vaclav Potesil,[3] Paul Holland,[7] Hazel Spence,[7] Alison Clubley,[7] Emma O'Dowd,[1] Matthew Clark,[8] Victoria Ashford-Turner,[9] Matthew EJ Callister,[9] Fergus V Gleeson[2]

ABSTRACT

Background: Estimation of the risk of malignancy in pulmonary nodules detected by CT is central in clinical management. The use of artificial intelligence (AI) offers an opportunity to improve risk prediction. Here we compare the performance of an AI algorithm, the lung cancer prediction convolutional neural network (LCP-CNN), with that of the Brock University model,recommended in UK guidelines.

Methods: A dataset of incidentally detected pulmonary nodules measuring 5–15 mm was collected retrospectively from three UK hospitals for use in a validation study. Ground truth diagnosis for each nodule was based on histology (required for any cancer), resolution, stability or (for pulmonary lymph nodes only) expert opinion. There were 1397 nodules in 1187 patients, of which 234 nodules in 229 (19.3%) patients were cancer. Model discrimination and performance statistics at predefined score thresholds were compared between the Brock model and the LCP-CNN.

Results: The area under the curve for LCP-CNN was 89.6% (95% CI 87.6 to 91.5), compared with 86.8% (95% CI 84.3 to 89.1) for the Brock model (p≤0.005). Using the LCP-CNN, we found that 24.5% of nodules scored below the lowest cancer nodule score, compared with 10.9% using the Brock score. Using the predefined thresholds, we found that the LCP-CNN gave one false negative (0.4% of cancers), whereas the Brock model gave six (2.5%), while specificity statistics were similar between the two models.

Conclusion: The LCP-CNN score has better discrimination and allows a larger proportion of benign nodules to be identified without missing cancers than the Brock model. This has the potential to substantially reduce the proportion of surveillance CT scans required and thus save significant resources.

RSNA Radiology

Artificial Intelligence Tool for Assessment of Indeterminate Pulmonary Nodules Detected with CT

Roger Y. Kim, Jason L. Oke, Lyndsey C. Pickup, Reginald F. Munden, Travis L. Dotson, Christina R. Bellinger, Avi Cohen, Michael J. Simoff, Pierre P. Massion, Claire Filippini, Fergus V. Gleeson, Anil Vachani

ABSTRACT

Background: Limited data are available regarding whether computer-aided diagnosis (CAD) improves assessment of malignancy risk in indeterminate pulmonary nodules (IPNs).

Purpose: To evaluate the effect of an artificial intelligence–based CAD tool on clinician IPN diagnostic performance and agreement for both malignancy risk categories and management recommendations.

Materials and Methods: This was a retrospective multireader multicase study performed in June and July 2020 on chest CT studies of IPNs. Readers used only CT imaging data and provided an estimate of malignancy risk and a management recommendation for each case without and with CAD. The effect of CAD on average reader diagnostic performance was assessed using the Obuchowski-Rockette and Dorfman-Berbaum-Metz method to calculate estimates of area under the receiver operating characteristic curve (AUC), sensitivity, and specificity. Multirater Fleiss κ statistics were used to measure interobserver agreement for malignancy risk and management recommendations.

Results: A total of 300 chest CT scans of IPNs with maximal diameters of 5–30 mm (50.0% malignant) were reviewed by 12 readers (six radiologists, six pulmonologists) (patient median age, 65 years; IQR, 59–71 years; 164 [55%] men). Readers' average AUC improved from 0.82 to 0.89 with CAD ($P < .001$). At malignancy risk thresholds of 5% and 65%, use of CAD improved average sensitivity from 94.1% to 97.9% ($P = .01$) and from 52.6% to 63.1% ($P < .001$), respectively. Average reader specificity improved from 37.4% to 42.3% ($P = .03$) and from 87.3% to 89.9% ($P = .05$), respectively. Reader interobserver agreement improved with CAD for both the less than 5% (Fleiss κ, 0.50 vs 0.71; $P < .001$) and more than 65% (Fleiss κ, 0.54 vs 0.71; $P < .001$) malignancy risk categories. Overall reader interobserver agreement for management recommendation categories (no action, CT surveillance, diagnostic procedure) also improved with CAD (Fleiss κ, 0.44 vs 0.52; $P = .001$).

Conclusion: Use of computer-aided diagnosis improved estimation of indeterminate pulmonary nodule malignancy risk on chest CT scans and improved interobserver agreement for both risk stratification and management recommendations.

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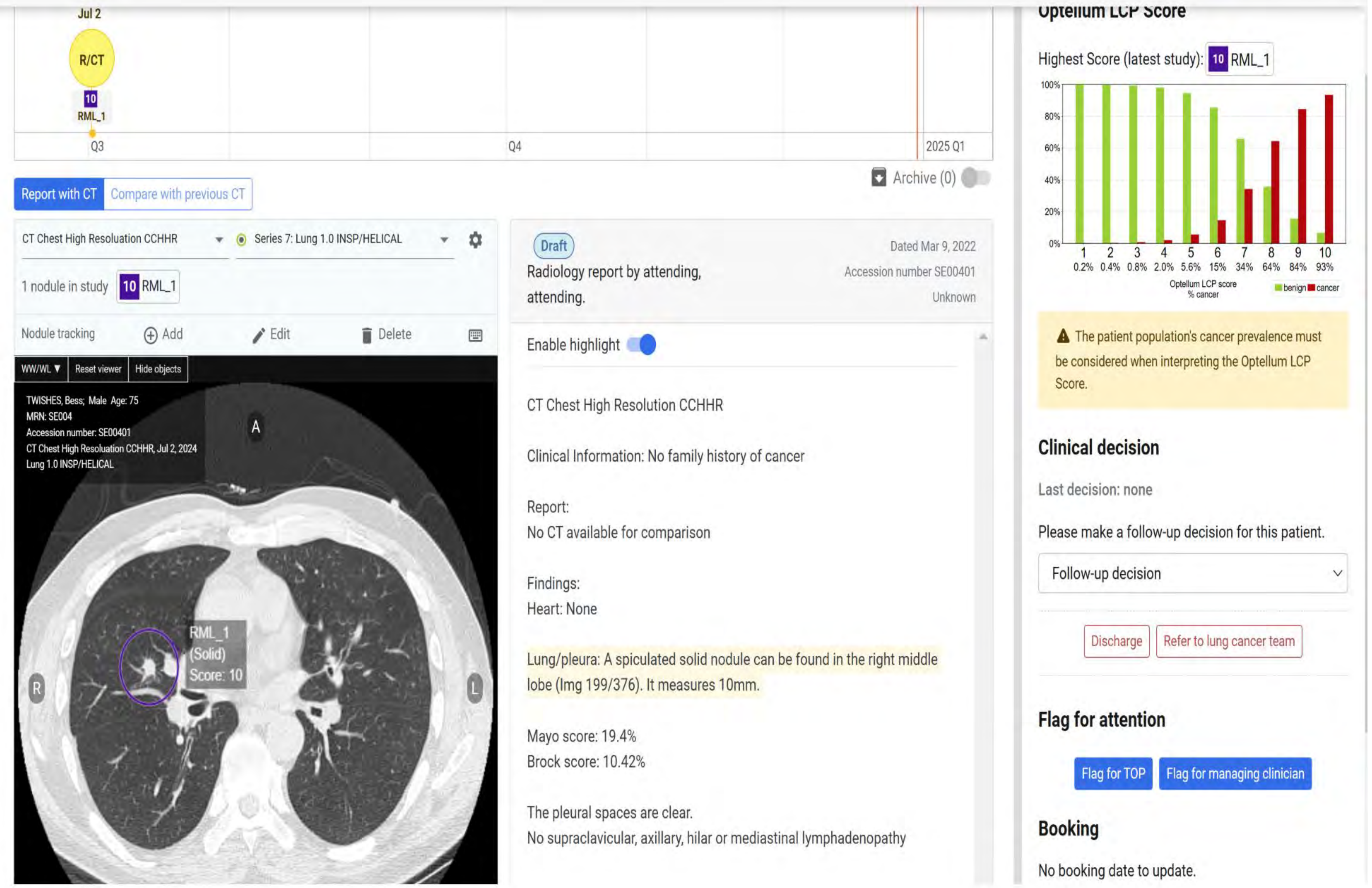
EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER.

NODULE ANALYSIS BY AI

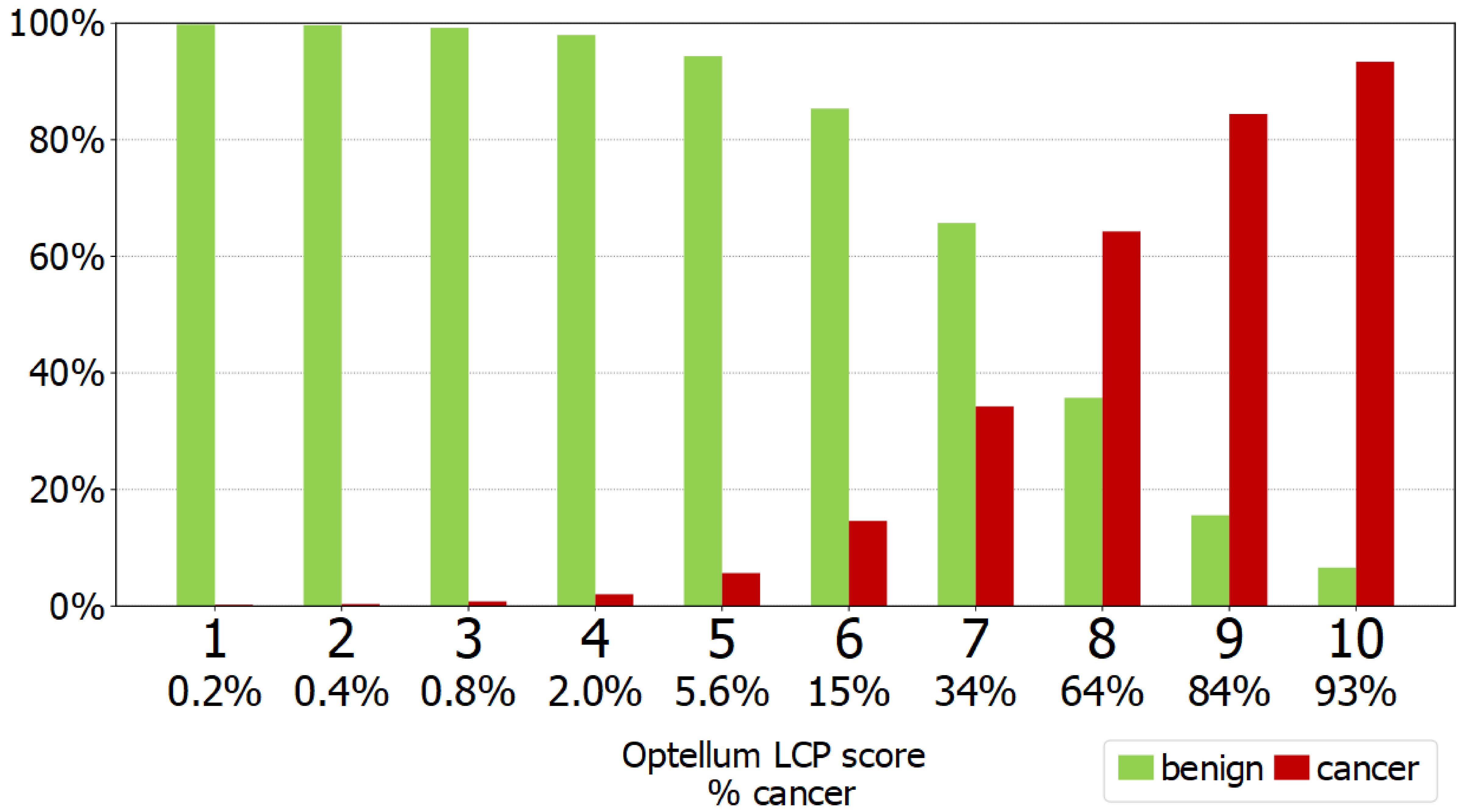


OPTELLUM

FDA APPROVED

Optellum Lung Cancer Prediction (LCP) score

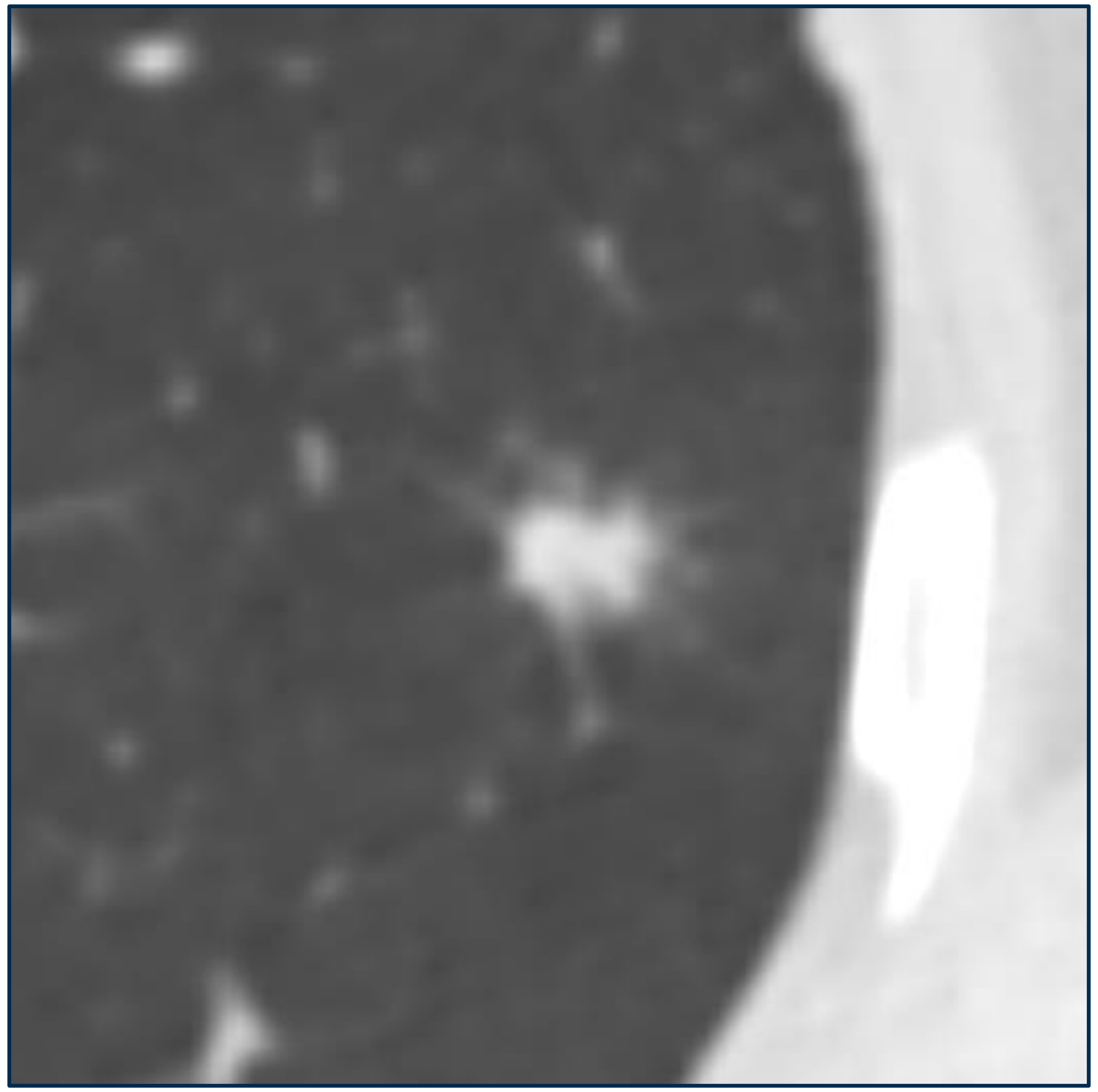
- The only FDA-cleared AI/Radiomics malignancy biomarker for incidentally detected nodules[1-3]
- Nodule malignancy score from 1 (benign) to 10 (malignant), based on neural network analysis of a standard CT
- Reimbursed by Medicare (CMS New Technology APC, $650/patient)
- Helps prioritize and guide the right patients/nodules into invasive procedures[4]
- Integrated into the Virtual Nodule Clinic platform - WellStar the first user in Georgia



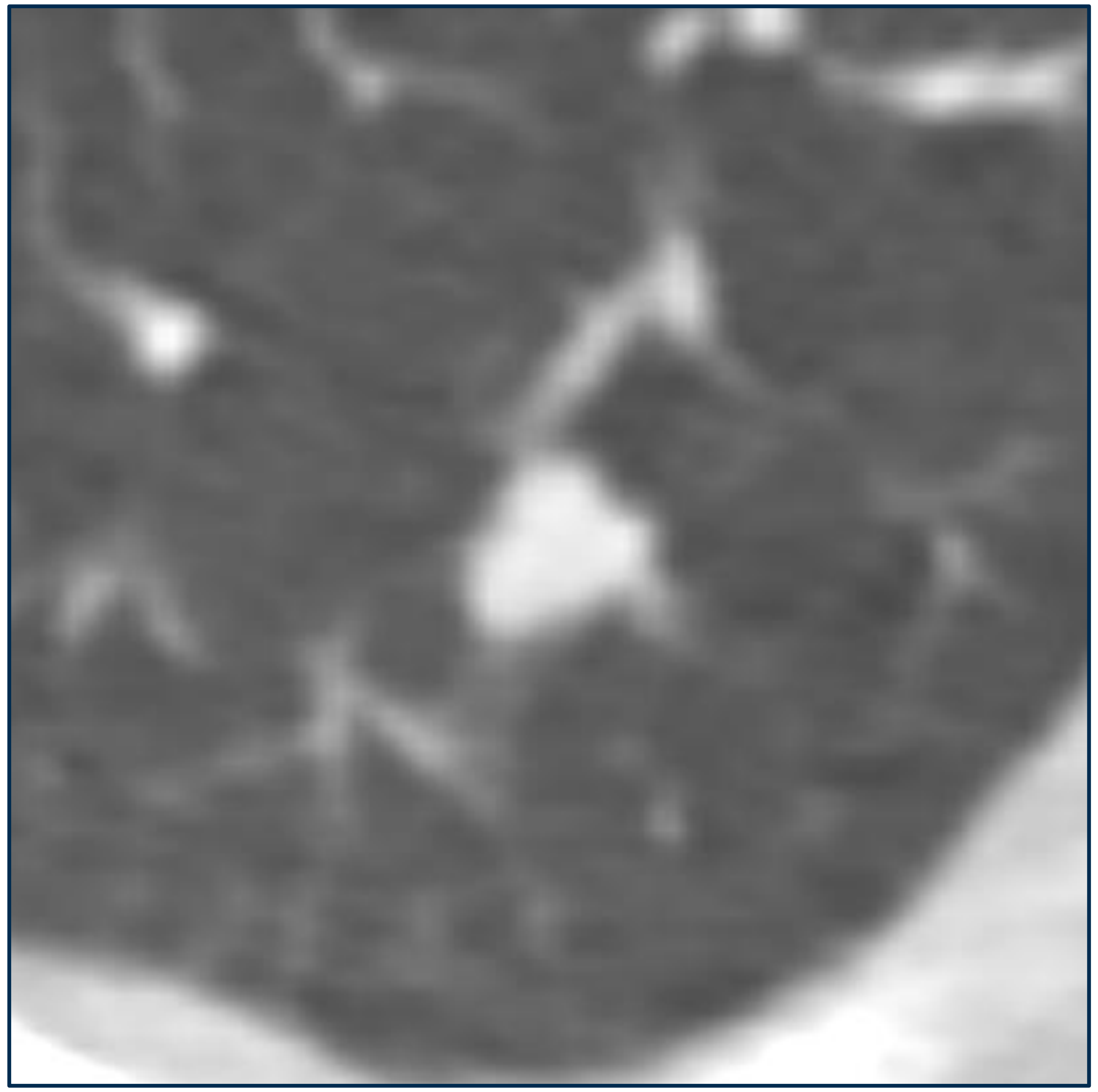
[1] Massion, Pierre P., et al. "Assessing the accuracy of a deep learning method to risk stratify indeterminate pulmonary nodules." *AJRCCM* 202.2 (2020): 241-249.
[2] Baldwin, David R., et al. "External validation of a convolutional neural network artificial intelligence tool to predict malignancy in pulmonary nodules." *Thorax* 75.4 (2020): 306-312.
[3] Kim, Roger Y., et al. Kim, Roger Y., et al. "Artificial intelligence tool for assessment of indeterminate pulmonary nodules detected with CT." Radiology 304.3 (2022): 683-691.
[4] Miller, Daniel., et al. "Clinical Application of an Artificial Intelligence Software for Prediction of Lung Cancer." STSA (2024)

Examples of malignant nodules

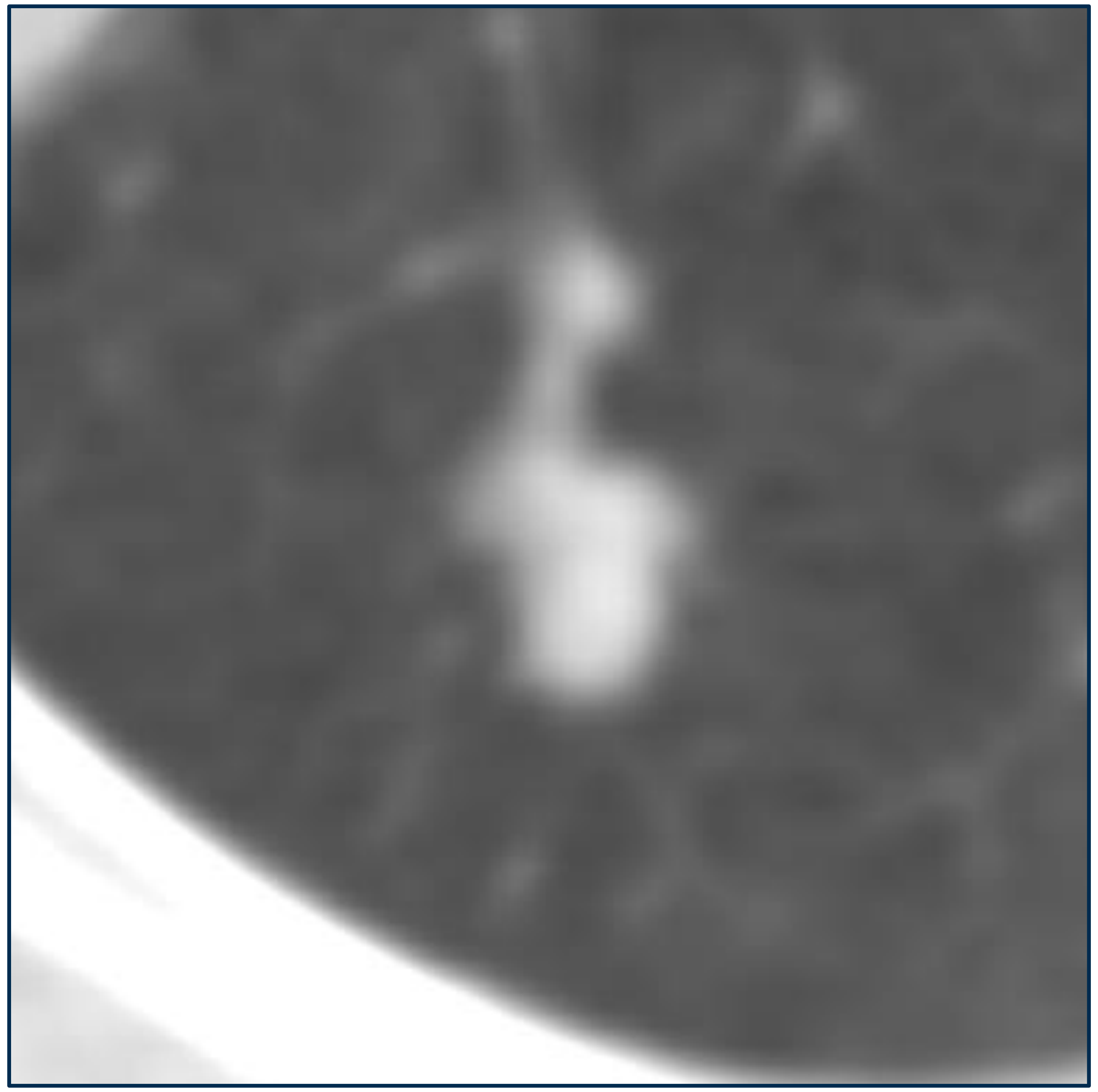
10mm



68yo M
8mm LUL
LCP score: 8
Adenocarcinoma



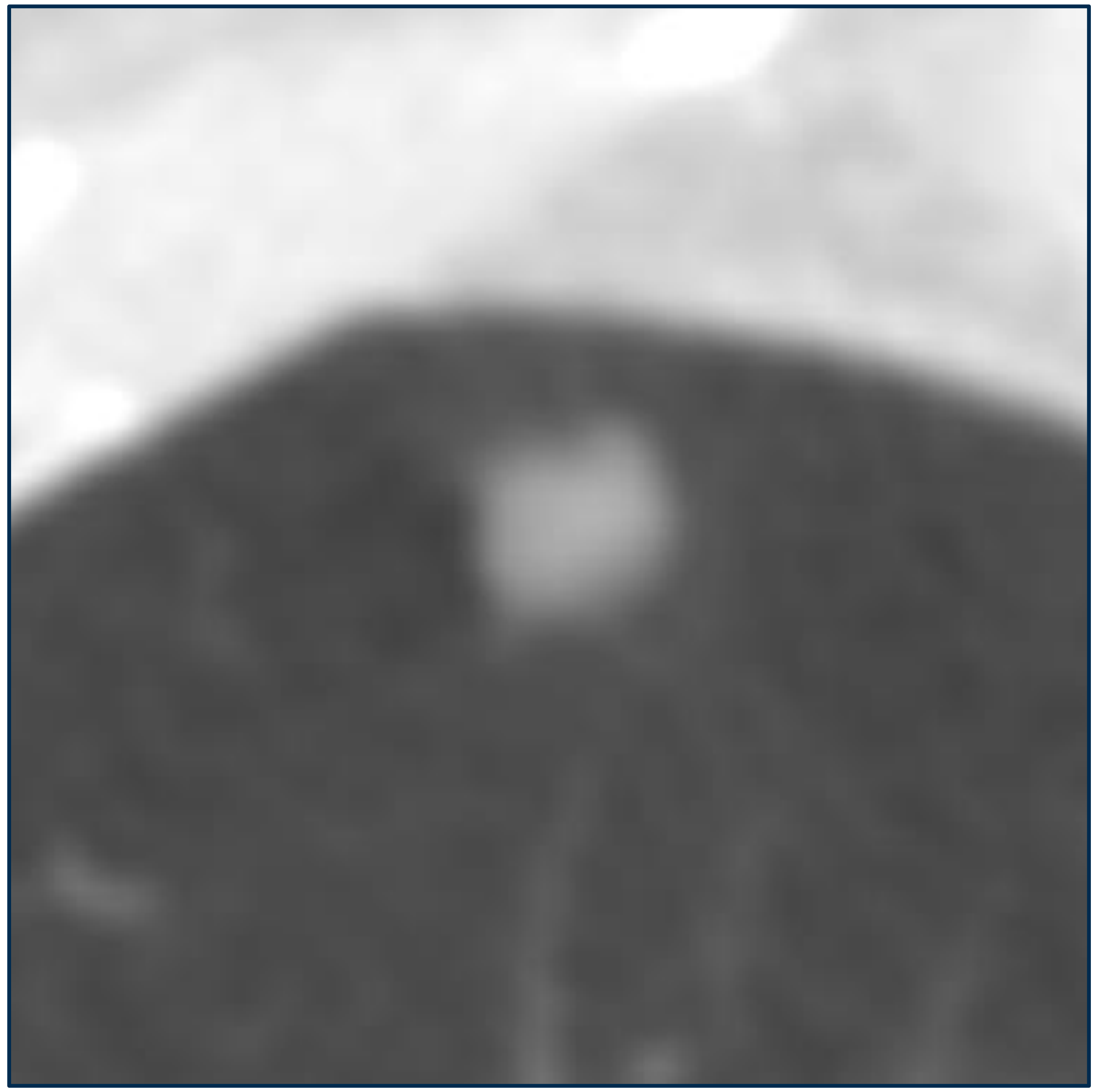
56yo F
8mm RUL
LCP score: 8
Adenocarcinoma



61yo F
10mm LLL
LCP score: 9
Adenocarcinoma

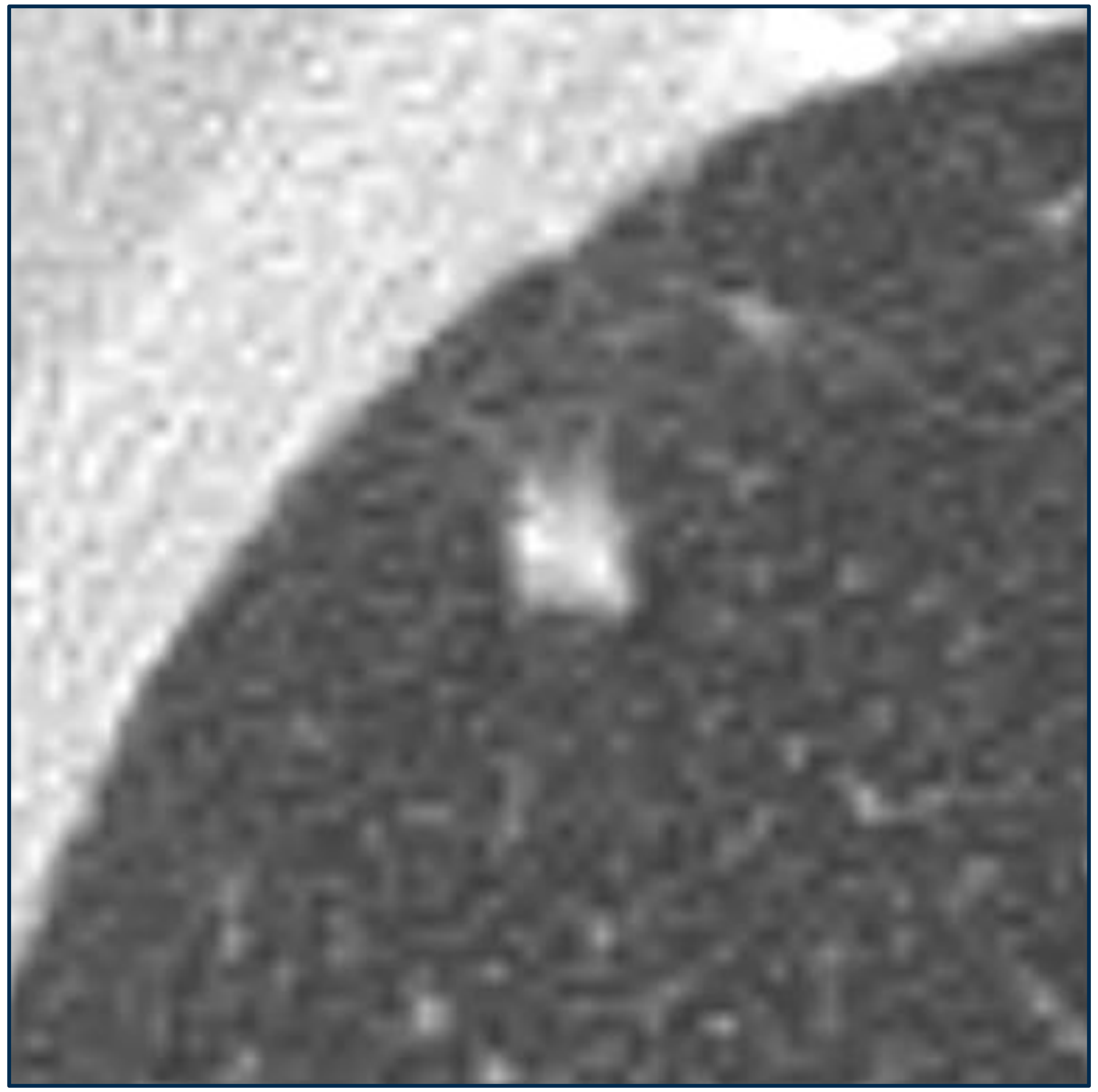
Examples of benign nodules

10mm



62yo M
8mm RML
LCP score: 2

48yo F
9mm RUL
LCP score: 5



47yo M
7mm RUL
LCP score: 3

Benign diagnosis based on stability

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

MITIGATE RISK

PATHWAYS: NOPATIENT LEFT BEHIND

Wellstar

PATHWAY MANAGEMENT

WELLSTAR LCO: NO PATIENT LEFT BEHIND

Name	MRN	Gender	Age	Creation Date	Status	Sub-status	Defer/Discard Reason	Unreviewed report	Due date	Notes	Assignee	Managed By Facility	Tags	Actions
		Male	70		Diagnostic Follow-up	Order		0	03 Apr 2024	4		WellstarMF _PH	≥ 8 mm - < 15 mm CT Now	⋮

Name	MRN	Gender	Age	Creation Date	Status	Sub-status	Defer/Discard Reason	Unreviewed report	Due date	Notes	Assignee	Managed By Facility	Tags	Actions
		Male	70		Diagnostic Follow-up	Order		0	12 Oct 2024	2		WellstarMF _NF	< 6 mm Density 12 months	⋮

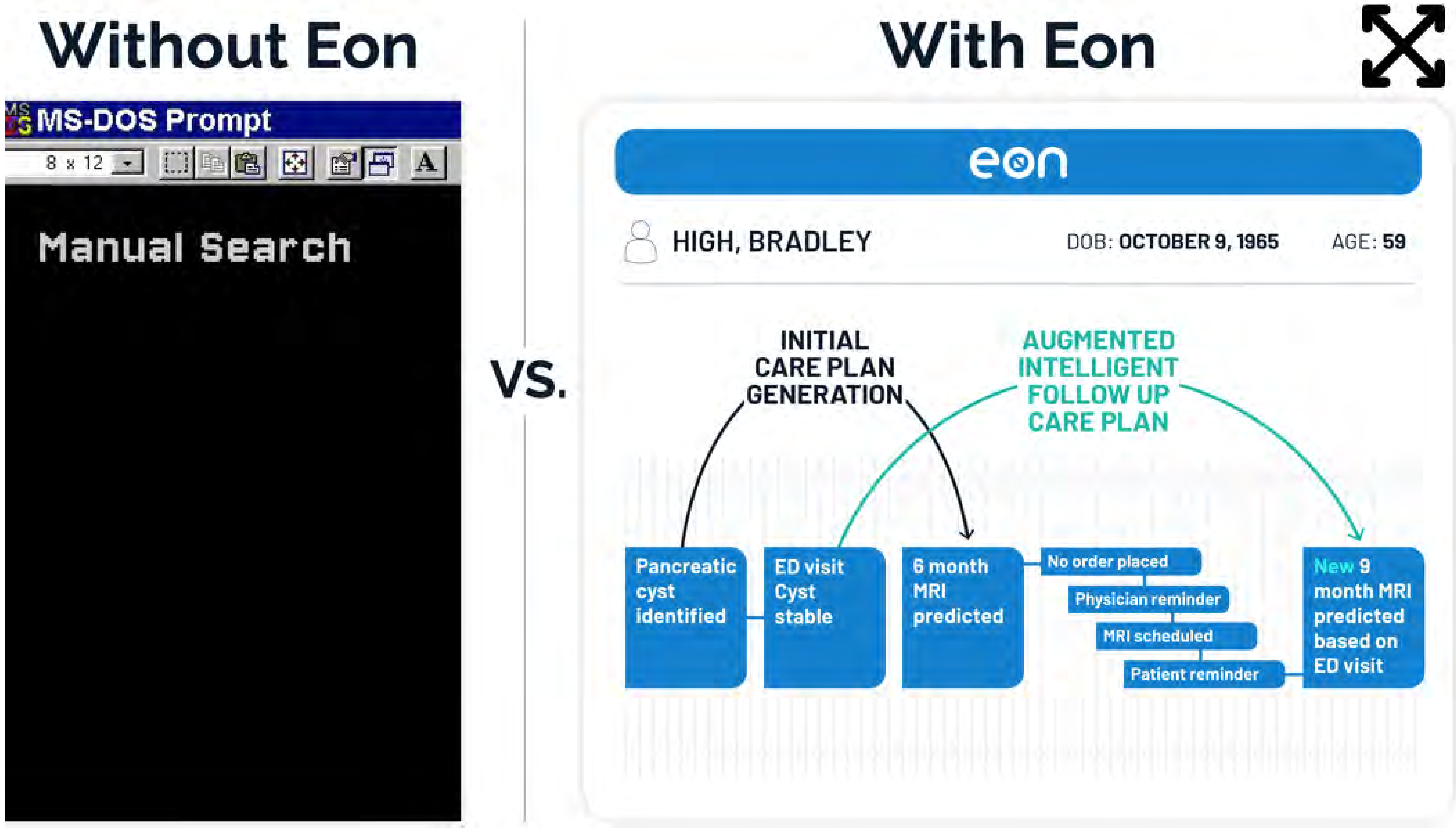
Manage Tags

Tags:

1 cm · Send Letter · Call Patient · 3 months · CT Now · Biopsy Pending · PFT/PET Pending · ILN Clinic

Cancel Confirm

PATHWAY MANAGEMENT



USUAL AND CUSTOMARY CARE **SPENDS 65 DAYS FROM ABNORMAL IMAGE TO DIAGNOSIS.**

AUTOMATED PATHWAYS SPEED THAT PROCESS.

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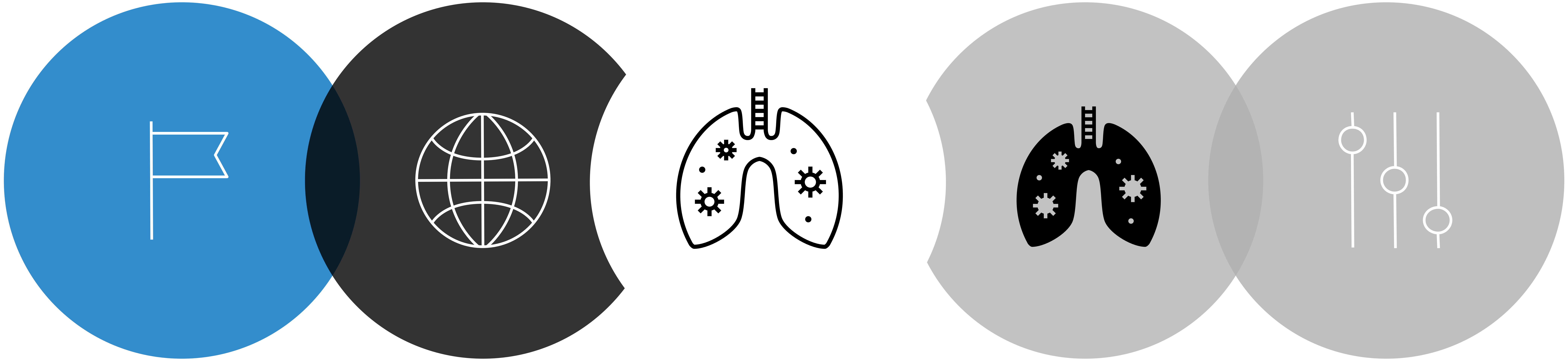
LIMITATIONS OF CURRENT AI APPLICATIONS

IT'S US



INCOMPLETE DATA

SMOKING HISTORY, RISK FACTOR DATA FOR MODELS

INCONSISTENT TERMINOLOGY

10 RADIOLOGISTS = TEN DIFFERENT DESCRIPTIONS

INCONSISTENT NODULE DETECTION

INTER-READER VARIABILITY

INCONSISTENT NODULE MEASUREMENT

GROSSLY INACCURATE USE OF CURSOR

UNSTRUCTURED DATA

AI HAS A HARD TIME PARSING OUT PHRASES AND NUMBERS

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EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER.

"EARLY DETECTION" MEANS JUST THAT:

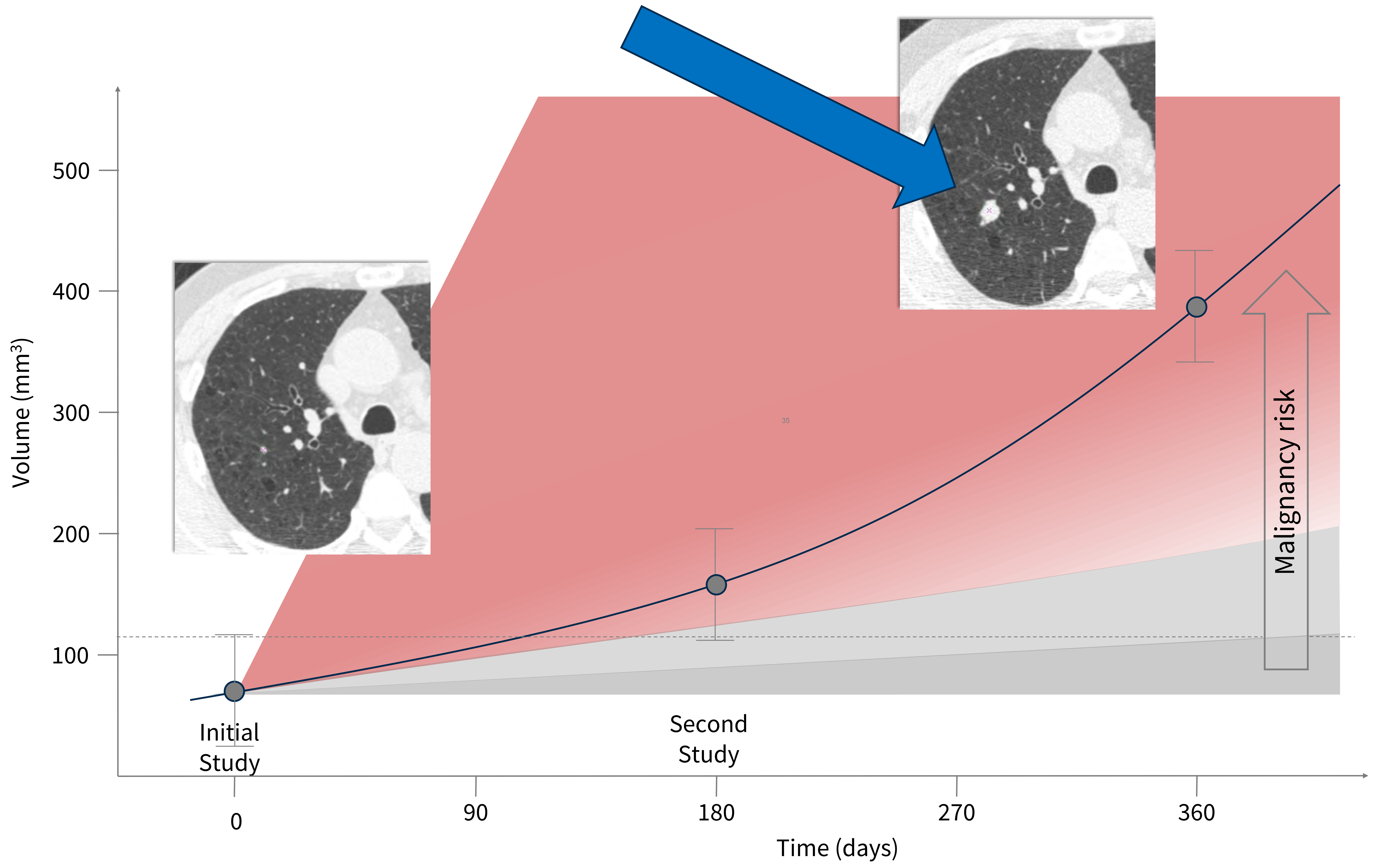
YOU ALREADY HAVE A CANCER AND WE NEED TO FIND IT EARLY

CAN WE SHIFT IMAGING FROM "REACTIVE" TO "PREDICTIVE"

Lung Cancer Timeline:

Turning “Early” into “Predictive” detection

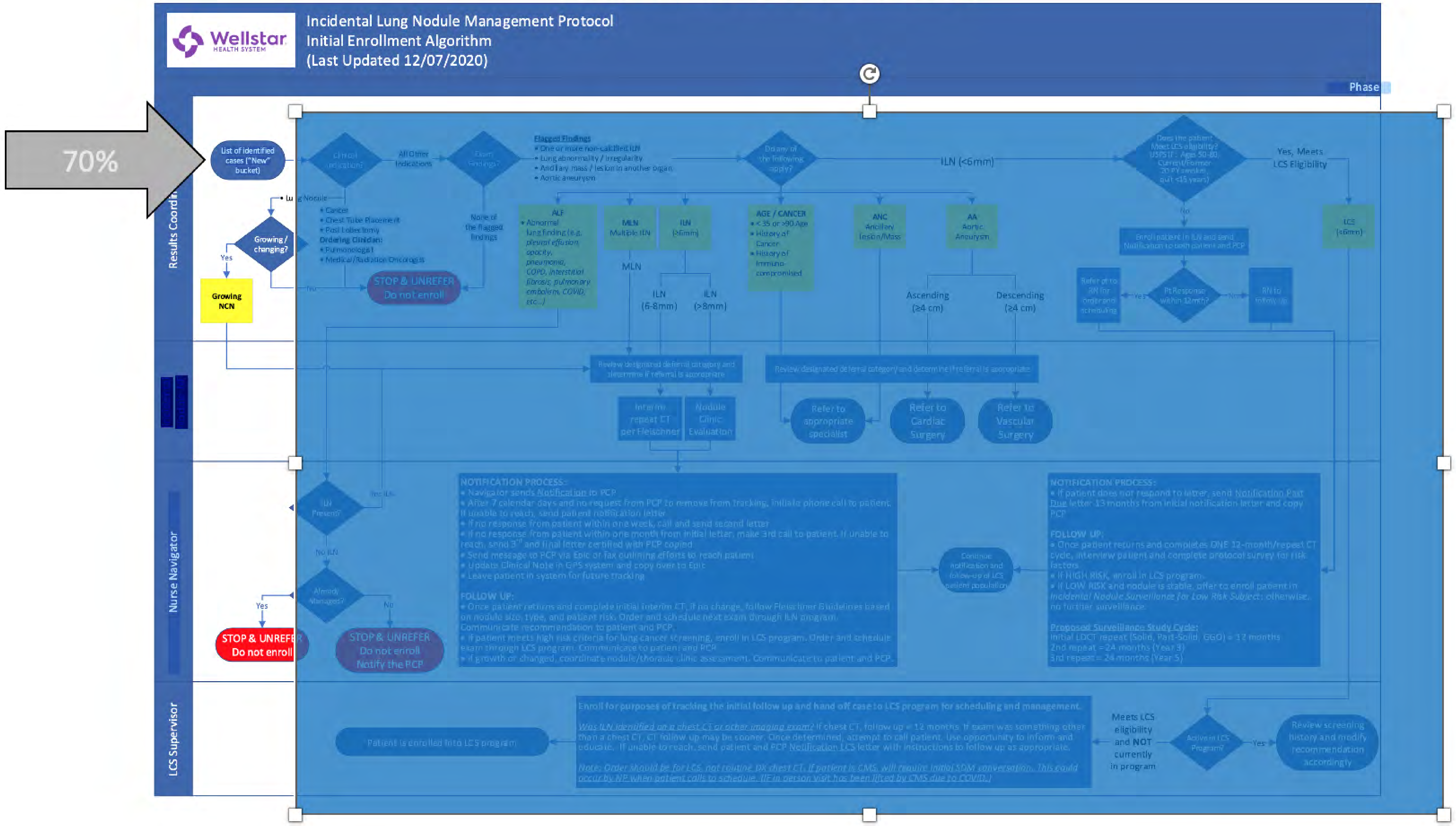
GE HealthCare



Depicted solid nodule growth pattern is an approximation based on suggestions in: "Growth patterns of screen-detected malignant pulmonary nodules: Accuracy of doubling-time models" A Creamer et al. European Respiratory Journal 2023; 62: Suppl. 67, OA3266 and is not necessarily indicative of the real clinical development

PREDICT

NO ONE DESERVES TO DIE OF LUNG CANCER



WHAT IF ?

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EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

Journal of Clinical Oncology®
An American Society of Clinical Oncology Journal

CURRENT ISSU

OPEN ACCESS | ORIGINAL REPORTS | January 12, 2023

Sybil: A Validated Deep Learning Model to Predict Future Lung Cancer Risk From a Single Low-Dose Chest Computed Tomography

Authors: Peter G. Mikhael, BSc, Jeremy Wohlwend, ME, Adam Yala, PhD, Ludvig Karstens, MSc, Justin Xiang, ME, Angelo K. Takigami, MD, Patrick P. Bourgouin, MD, ... SHOW ALL ..., and Regina Barzilay, PhD | AUTHORS INFO & AFFILIATIONS

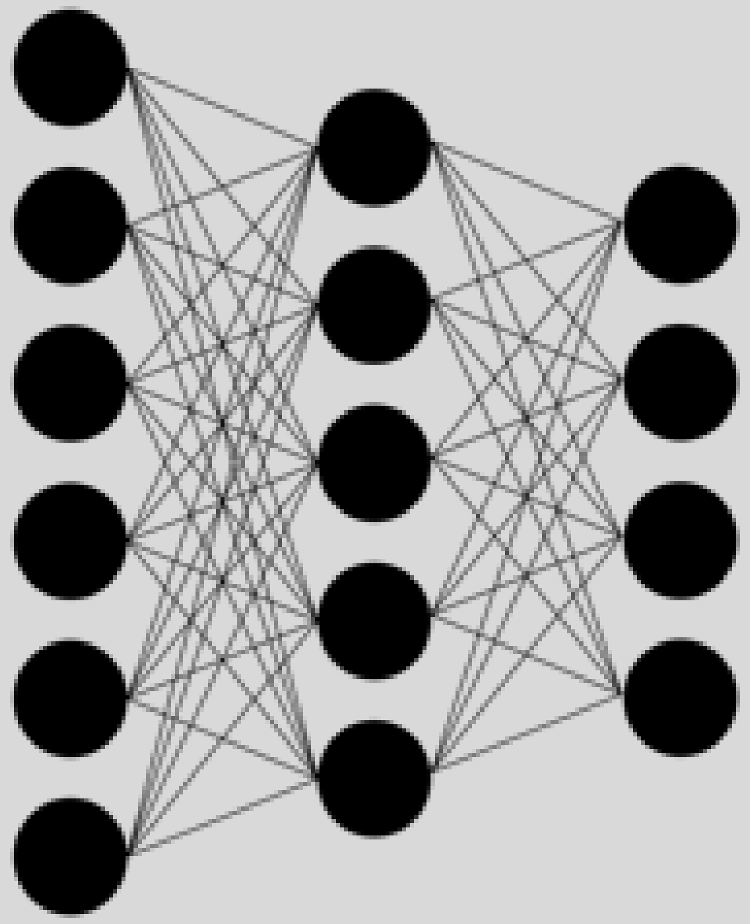
Publication: Journal of Clinical Oncology • Volume 41, Number 12
https://doi.org/10.1200/JCO.22.01345

NOT FDA APPROVED

SYBIL

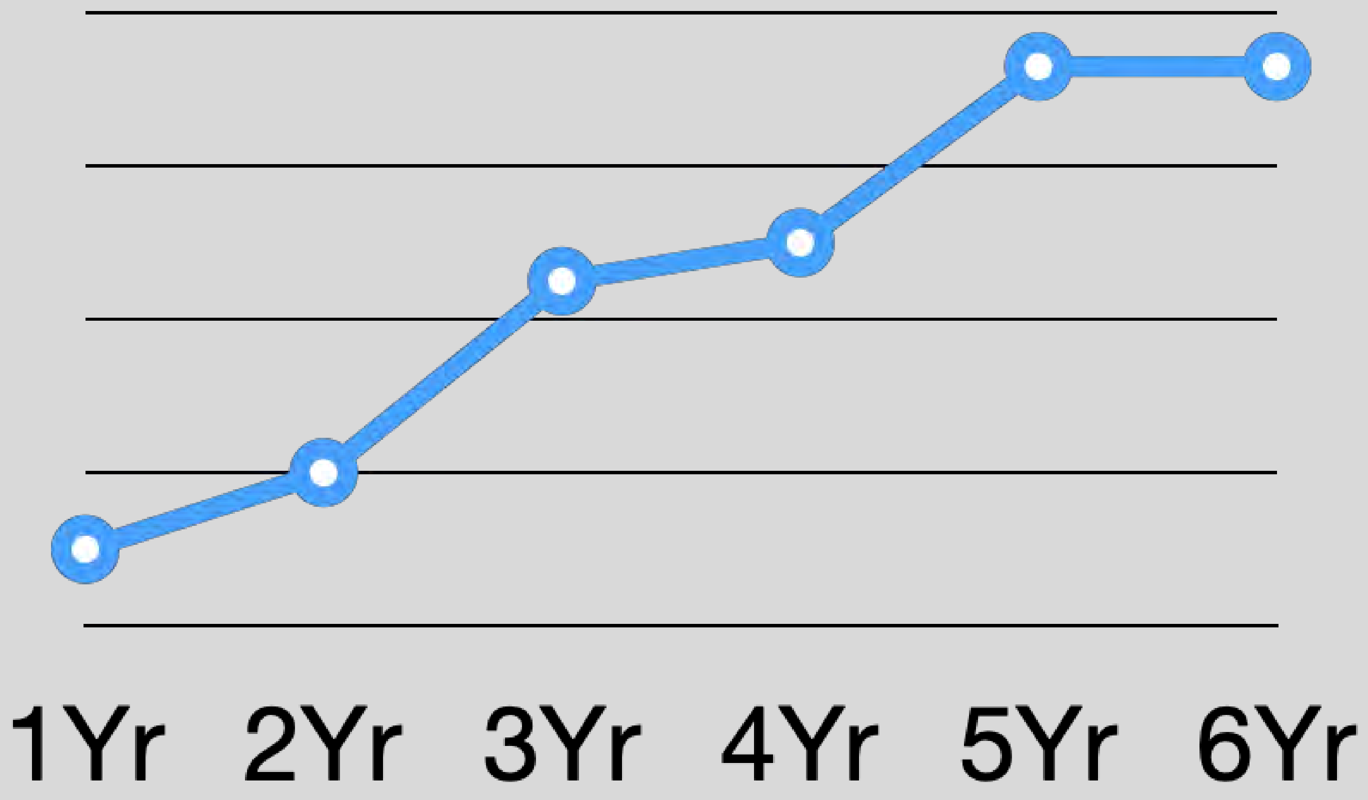
Deep Learning Algorithm trained on > 44K LDCT exams from 15K subjects in **NLST trial**

AXIAL CT IMAGE DATA



CONVOLUTIONAL NEURAL NETWORK

RUNS ON AN IMAC OR PC



NUMERIC OUTPUT OF CUMULATIVE ANNUAL RISK

Mikhael, *J Clin Oncol* 2023

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER.

SYBIL PREDICTS LUNG CANCER FROM A SINGLE LDCT

Mikhael, *J Clin Oncol* 2023

SINGLE CT

LOW DOSE CT OF THE CHEST

NO CLINICAL INPUT REQUIRED

NO NODULE REQUIRED

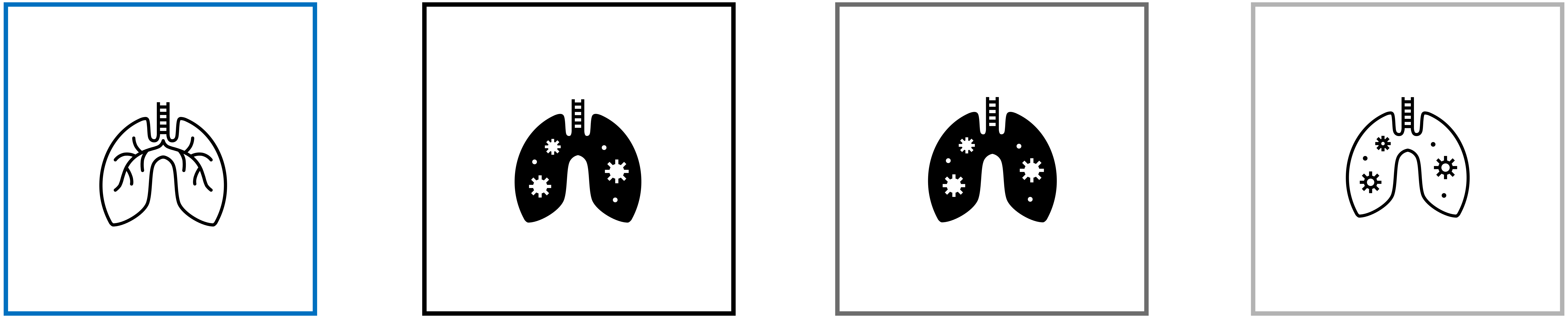
IMMEDIATELY REPORTS 1 – 6 YEAR RISK

NO EXTERNAL TRANSFER OF IMAGES OR DATA

NO NODULE OR ANNOTATION REQUIRED

SYBIL "READS" THE LDCT AND PREDICTS FUTURE LUNG CANCER

SYBIL SIMPLY READS THE LDCT

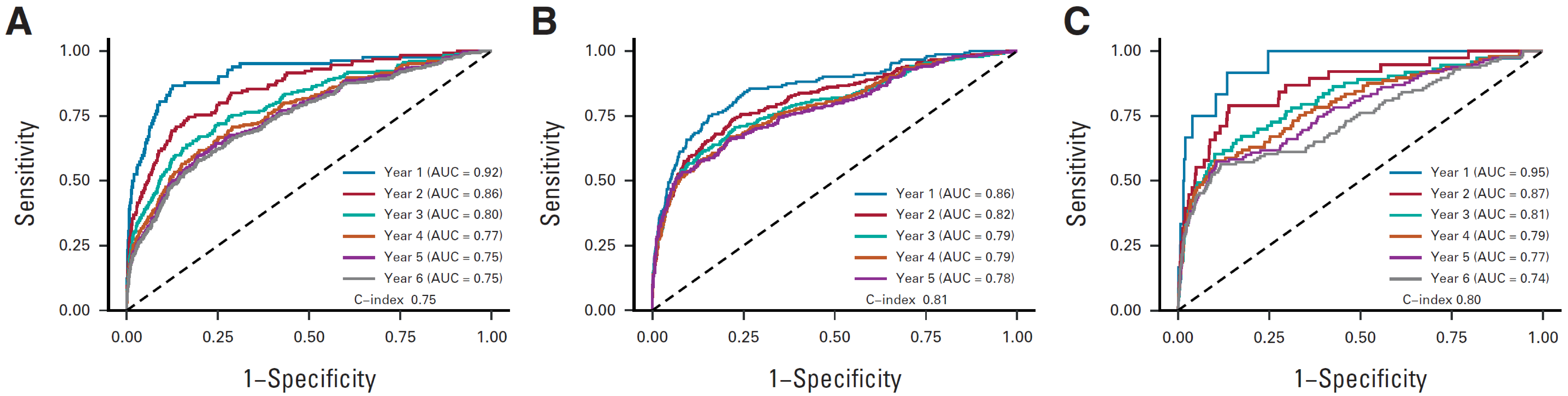


“EARLY DETECTION IS GOOD.

CANCER PREDICTION IS BETTER.”

ILYA GIPP, MD, PHD

Sybil Performance



NLST, n=6,282

MGH, n=8,862

CGMH, n= 12,280

Mikhael, *J Clin Oncol* 2023

KEY ADVANTAGES

No image annotation

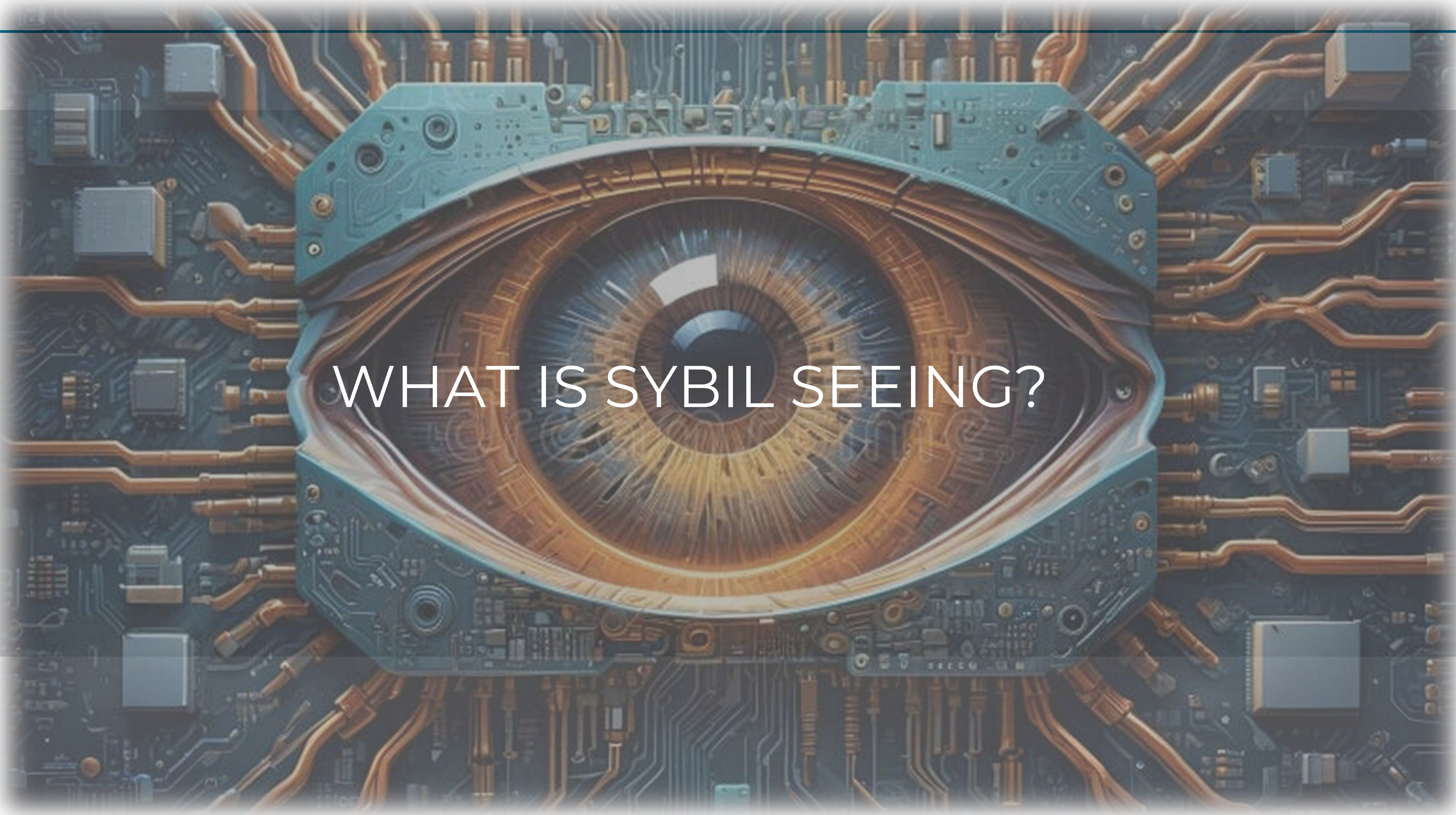
No clinical data needed

Instant readouts

Cumulative multi-year future risk stratification from a single LDCT

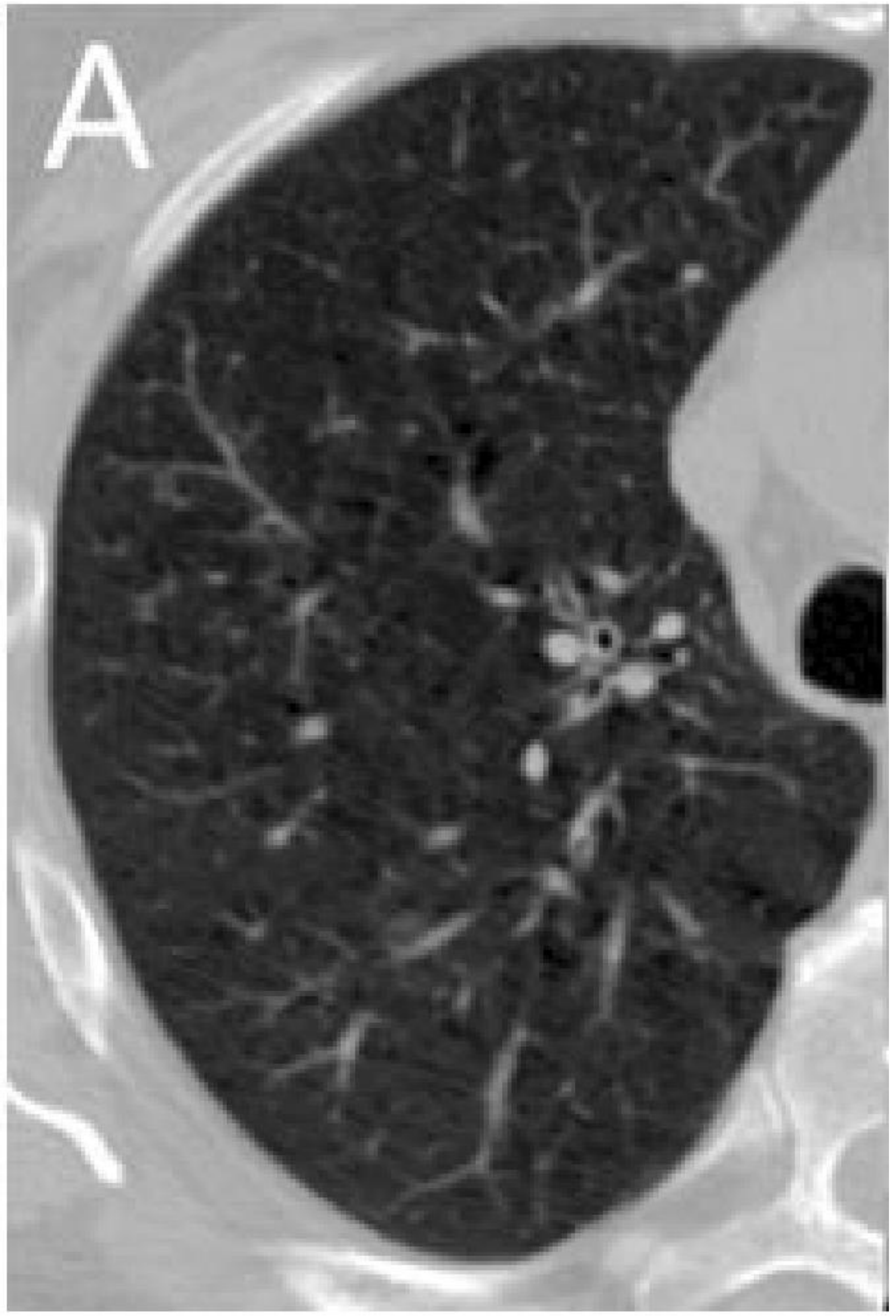
Mikhael, *J Clin Oncol* 2023

Most Common Question



WHAT IS SYBIL SEEING?

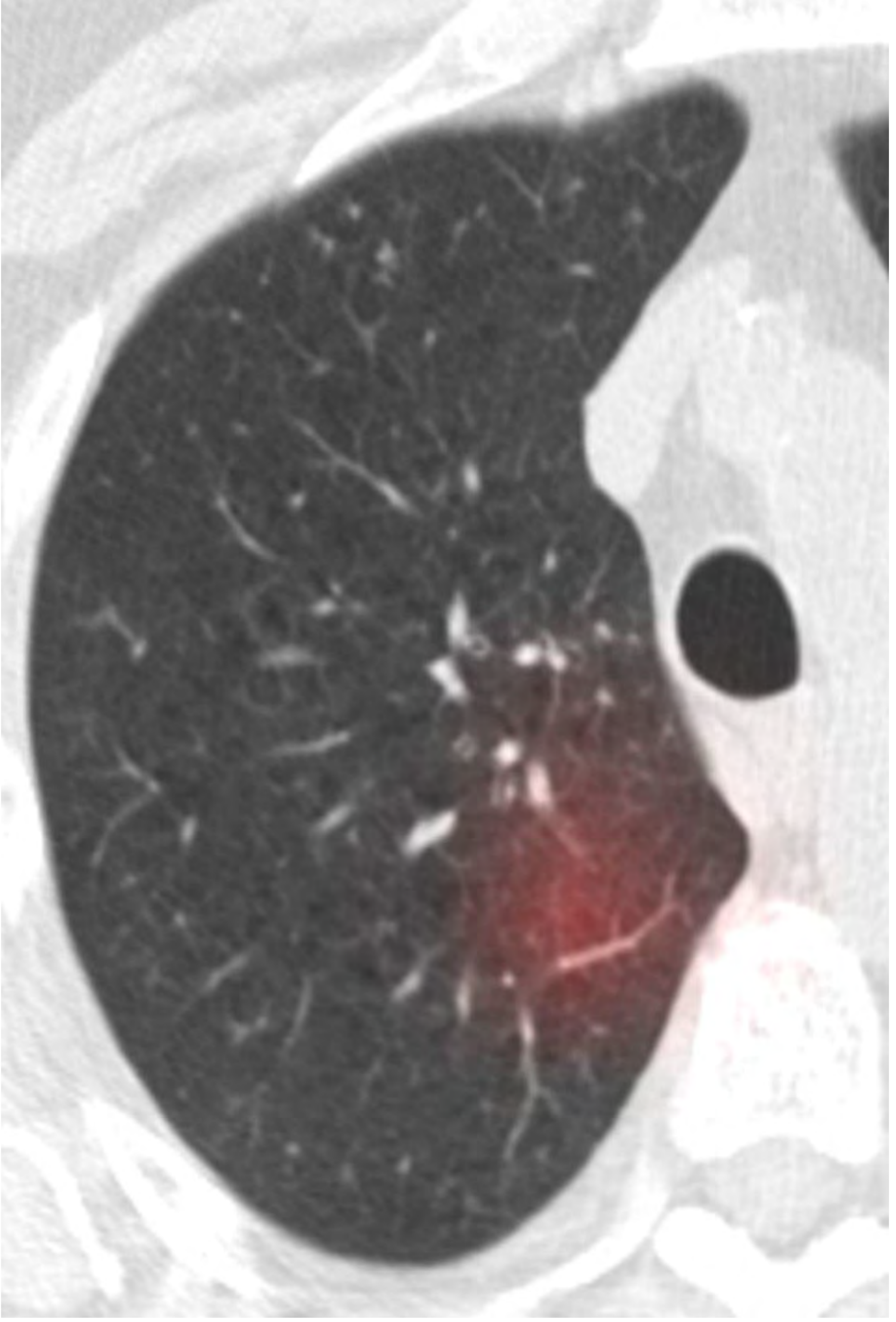
What is Sybil Seeing?



69-year-old male with
99 pack-year smoking hx

Baseline scan read as "negative screen, minor abnormalities not suspicious for lung cancer"

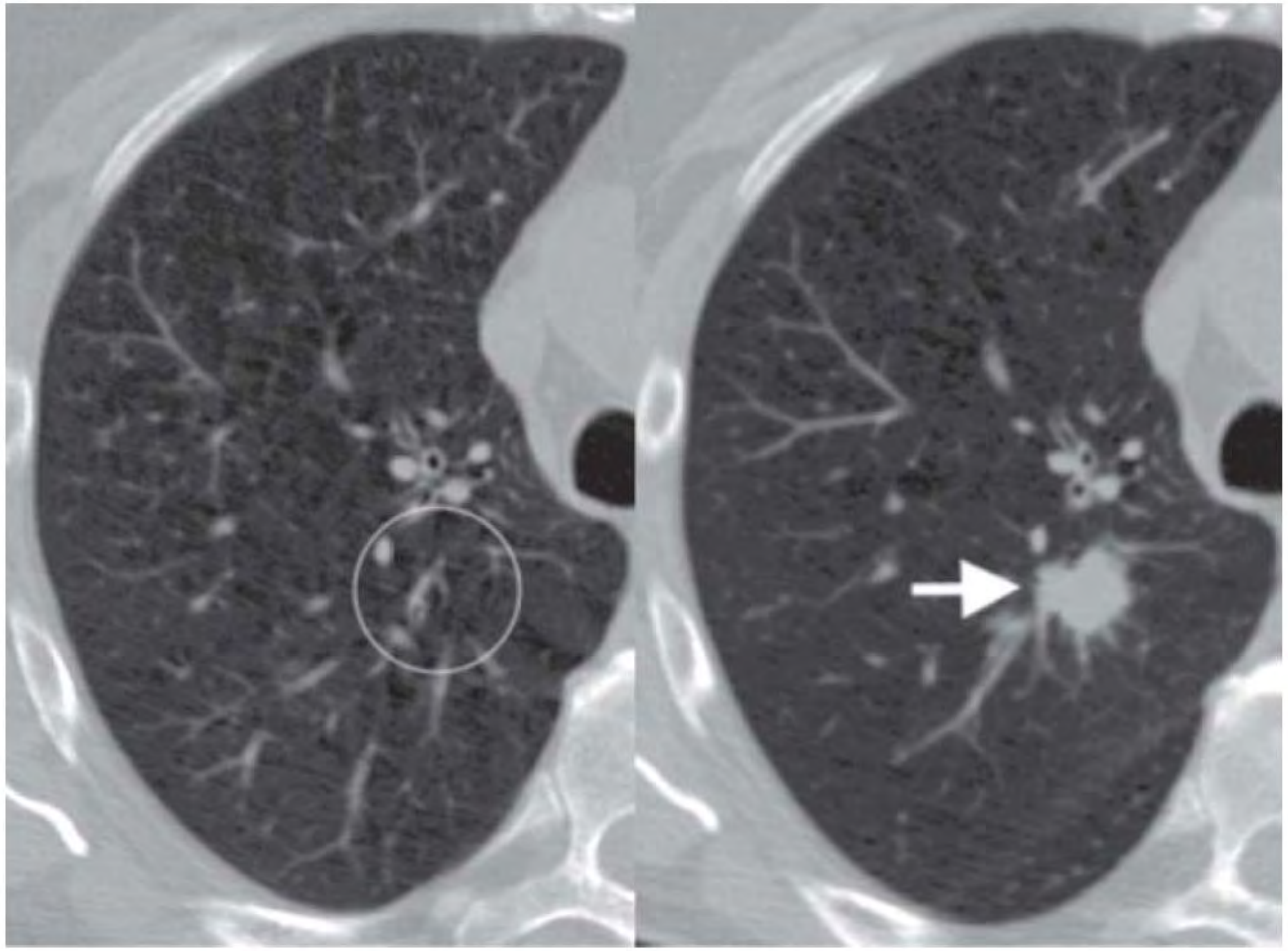
Sybil placed scan in **75% risk percentile** (6-year risk)



Mikhael, *J Clin Oncol* 2023

Sybil "attention map"
(note this is *not* a PET scan)

What is Sybil Seeing?



Mikhael, *J Clin Oncol* 2023

One year followup

2.2 cm poorly-differentiated squamous cell lung cancer

Surgical resection (pT1cN0)

SYBIL READS THE RAW LDCT DATA, NOT THE VISUAL ALGORITHM

HUMANS SEE THE VISUAL ALGORITHM

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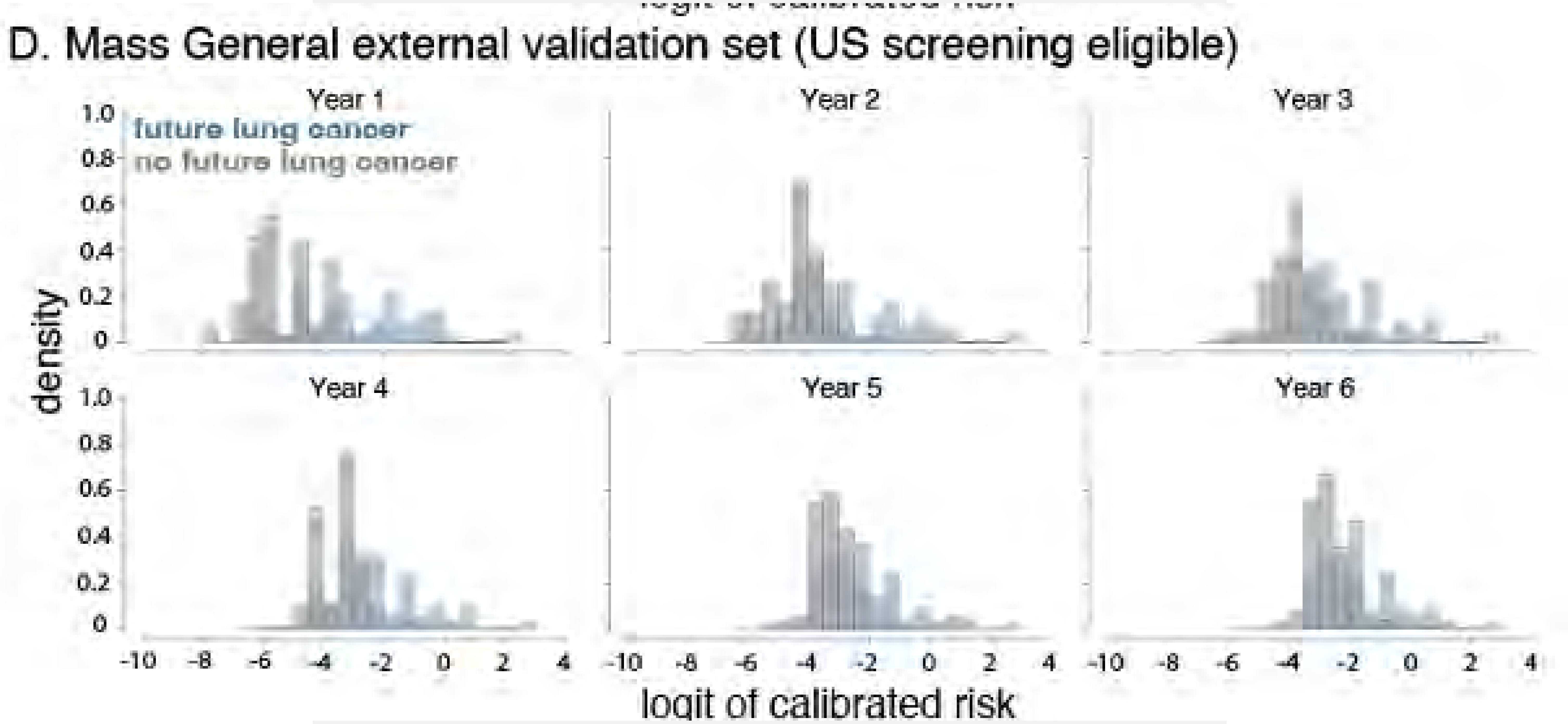
EARLY DETECTION IS GOOD. CANCER PREDICTION IS BETTER.

CLINICAL UTILITY

70% ACCURATE IN SELECTING PATIENTS WHO WILL DEVELOP LUNG CANCER

A LOW SYBIL SCORE WILL NOT PREVENT FURTHER FOLLOW UP

A HIGH SYBIL SCORE WILL PROMOTE MORE CAREFUL FOLLOW UP



EARLY DETECTION IS GOOD. CANCER PREDICTION IS BETTER.

SYBIL CONSORTIUM

VALIDATION STUDIES:

DIVERSE POPULATION OF SUBJECTS

HIGH VOLUMES

STANDARDIZED DATA SET

PROSPECTIVE VALIDATION OF DLA IN INCIDENTALS

RETROSPECTIVE VALIDATION OF DLA

EARLY DETECTION IS GOOD. CANCER PREDICTION IS BETTER.

LUNG CANCER PREDICTION

SYBIL
- READS LDCT
- SIX YEAR RISK

LUMAS
- READS LDCT
- ONE YEAR RISK

XGBOOST
- EMR DATA MINING
- ONE YEAR RISK

nature medicine LETTERS
https://doi.org/10.1038/s41591-019-0447-x

End-to-end lung cancer screening with three-dimensional deep learning on low-dose chest computed tomography

Diego Ardila[1,5], Atilla P. Kiraly[1,5], Sujeeth Bharadwaj[1,5], Bokyung Choi[1,5], Joshua J. Reicher[2], Lily Peng[1], Daniel Tse[1*], Mozziyar Etemadi[3], Wenxing Ye[1], Greg Corrado[1], David P. Naidich[4] and Shravya Shetty[1]

With an estimated 160,000 deaths in 2018, lung cancer is the most common cause of cancer death in the United States[1]. Lung cancer screening using low-dose computed tomography has been shown to reduce mortality by 20–43% and is now included in US screening guidelines[1–6]. Existing challenges include inter-grader variability and high false-positive and false-negative rates[7–10]. We propose a deep learning algorithm that uses a patient's current and prior computed tomography volumes to predict the risk of lung cancer. Our model achieves a state-of-the-art performance (94.4% area under the curve) on 6,716 National Lung Cancer Screening Trial cases, and performs similarly on an independent clinical validation set of 1,139 cases. We conducted two reader studies. When prior computed tomography imaging was not available, our model outperformed all six radiologists with absolute reductions of 11% in false positives and 5% in false negatives. Where prior computed tomography imaging was available, the model performance was on-par with the same radiologists. This creates an opportunity to optimize the screening process via computer assistance and automation. While the vast majority of patients remain unscreened, we show the potential for deep learning models to increase the accuracy, consistency and adoption of lung cancer screening worldwide.

limitations suggest opportunities for more sophisticated systems to improve performance and inter-reader consistency[18,19]. Deep learning approaches offer the exciting potential to automate more complex image analysis, detect subtle holistic imaging findings and unify methodologies for image evaluation[20].

A variety of software devices have been approved by the Food and Drug Administration (FDA) with the goal of addressing workflow efficiency and performance through augmented detection of lung nodules on lung computed tomography (CT)[21]. Clinical research has primarily focused on either nodule detection or diagnostic support for lesions manually selected by imaging experts[22–27]. Nodule detection systems were engineered with the goal of improving radiologist sensitivity in identifying nodules while minimizing costs to specificity, thereby falling into the category of computer-aided detection (CADe)[28]. This approach highlights small nodules, leaving malignancy risk evaluation and clinical decision making to the clinician. Diagnostic support for pre-identified lesions is included in computer-aided diagnosis (CADx) platforms, which are primarily aimed at improving specificity. CADx has gained greater interest and even first regulatory approvals in other areas of radiology, though not in lung cancer at the time of manuscript preparation[29].

To move beyond the limitations of prior CADe and CADx

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER

FUTURE

FDA APPROVED ARTIFICIAL INTELLIGENCE

692

AI ENABLED MEDICAL DEVICES IN HEALTHCARE (SAAD)

77%

RADIOLOGY

FEW

LUNG CANCER

AZRA AI

EON

LUNG CANCER ORCHESTRATOR

RIVERAIN

OPTELLUM

MY DREAM TEAM OF FEATURES

Wellstar

LUNG SCREENING

NODULE DETECTION →
- REDUCES VARIABILITY
- PERFORMS LOOK BACK

NODULE TABLE →
- ELIMINATES TRANSCRIPTION TIME

STRATIFICATION →
- IDENTIFIES HIGHER RISK NODULES

NODULE ANALYSIS →
- REDUCE NEGATIVE BIOPSIES

CLINICAL PATHWAY
- REDUCE TIME TO DIAGNOSIS AND TREATMENT

SYBIL CANCER PREDICTION → CLINICAL PATHWAY

MY DREAM TEAM OF FEATURES

INCIDENTAL NODULES

DATA MINING OF EMR AND REPORTS
- IDENTIFY PATIENTS AT RISK

→

AUTOMATIC SORTING IN EMR
- STRATIFIES THOSE AT RISK
- PULL THE CT SCAN

→

NODULE ANALYSIS
- ANALYZE NODULES
- REDUCE NEGATIVE BIOPSIES

→

CLINICAL PATHWAY
- REDUCE TIME TO DIAGNOSIS AND TREATMENT

SYBIL CANCER PREDICTION → CLINICAL PATHWAY

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AI WILL DISRUPT OUR CURRENT MANUAL PROCESSES

IMPROVE EFFICIENCY AND QUALITY

- IDENTIFY RISK
- STRATIFY RISK
- ANALYZE RISK
- MITIGATE RISK

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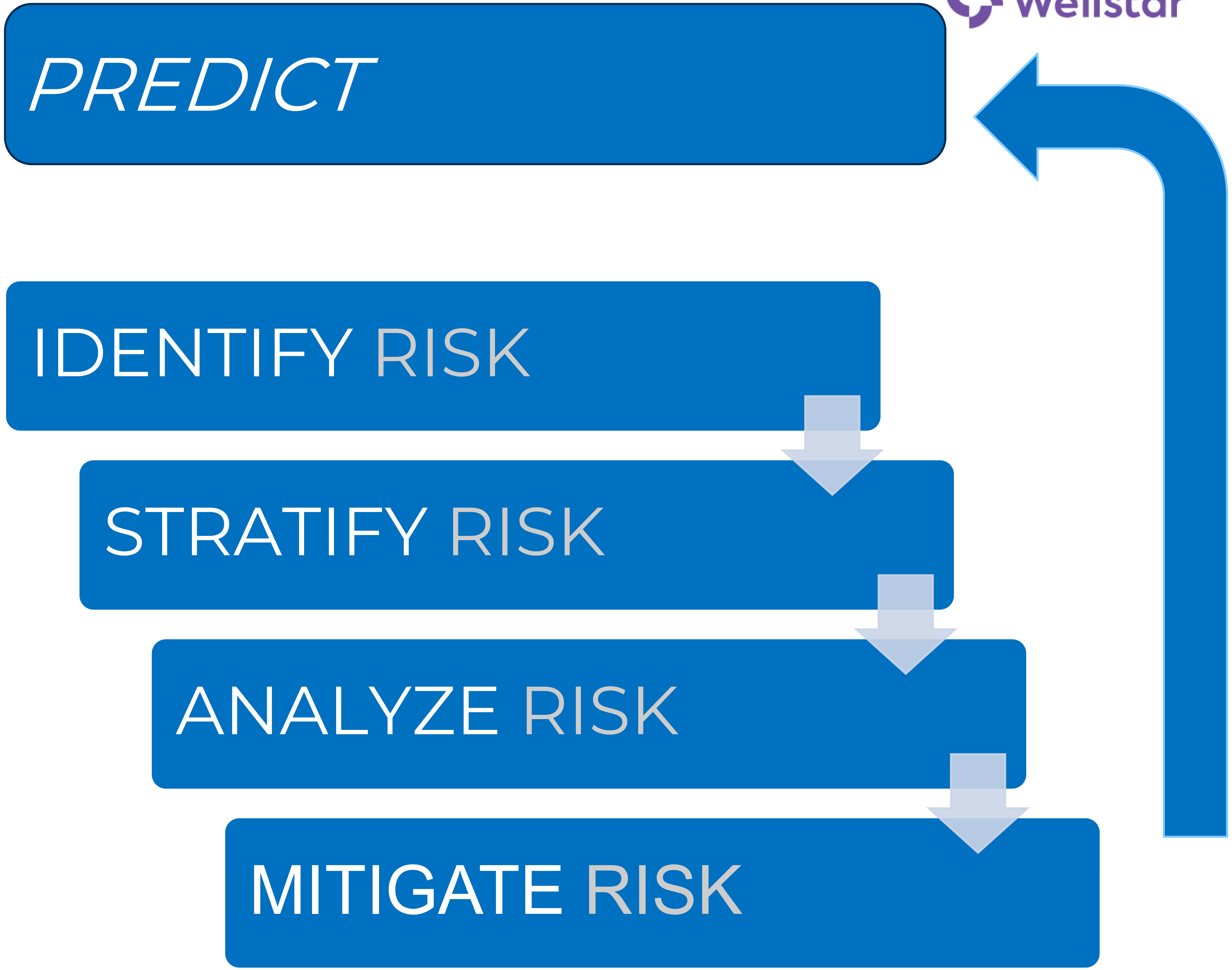
AI MAY
PREDICT
THE ONSET
OF LUNG
CANCER

REDUCE
TIME TO
DIAGNOSIS



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THE FUTURE for AI in Lung Cancer

Data Management

- **Convert Unstructured data to Structured**
- **Data Mining**

Population Health

- Refine Population Risk assessment
- Refine Lung Screening criteria
- Address Social Determinants of Health

Risk stratification

- Refine NLP referral for review

Nodule Management

- Improved specificity in nodule detection
- Improved sensitivity for GGOs

Treatment and Outcomes

- Determine best treatment based on all factors known
- **Predict outcomes based on all factors known**

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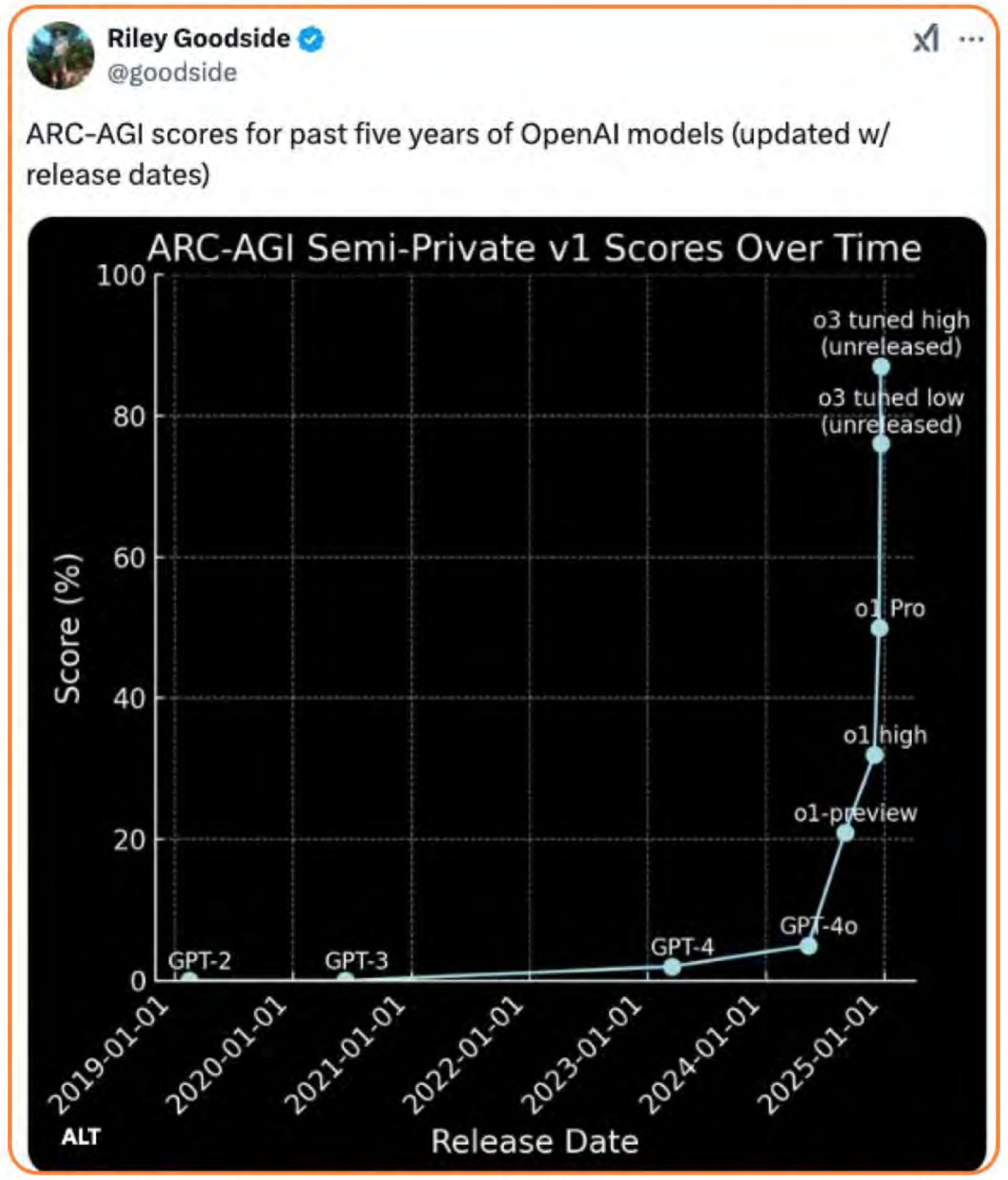
A.I. IS THE WORST IT WILL EVER BE !



FYI, this performance on the ARC-AGI test stirred up some controversy... here's a good recap video on the drama.

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EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER.

THE FUTURE'S SO BRIGHT, I GOTTA WEAR SHADES

"The Future's So Bright I Gotta Wear Shades",
Timbuk3, 1986, written by Pat MacDonald.
Copyright I.R.S. Records

EARLY DETECTION IS GOOD, CANCER PREDICTION IS BETTER.

APPENDIX

Outcomes From More Than 1 Million People Screened for Lung Cancer With Low-Dose CT Imaging

Wellstar

Gerard A. Silvestri, MD; Lenka Goldman; Nichole T. Tanner, MD, MSCR; Judy Burleson; Michael Gould; Ella A. Kazerooni, MD; Peter J. Mazzone, MD, MPH; M. Patricia Rivera, MD; V. Paul Doria-Rose, DVM, PhD; Lauren S. Rosenthal, MPH; Michael Simanowith; Robert A. Smith, PhD; and Stacey Fedewa, PhD

Conclusion (from abstract):

This study revealed both the positive aspects of CT scan screening for lung cancer and the challenges in implementing screening nationally. Reassuringly, most patients met criteria to be screened. Findings on CT imaging were correlated accurately with lung cancer detection using the Lung-RADS system. A significant stage shift toward early-stage lung cancer was found. However, **adherence to lung cancer screening was poor, was more likely to occur in the underserved**, and likely contributes to the lower than expected cancer detection rate, all of which will impact the outcomes of patients undergoing screening for lung cancer.

Silvestri, *Chest* 2023

NO ONE DESERVES TO DIE OF LUNG CANCER

"WE GET ONE CHANCE"

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6%

ONLY 6% OF THOSE ELIGIBLE GET SCREENED

75%

75% WILL NEVER GET A SECOND SCAN, WHEN ½ ARE DISCOVERED

1

1 SCAN, DONE FOR ANOTHER REASON, DETECTS THE INCIDENTAL NODULE

HIGH SENSITIVITY, LOW SPECIFICITY, ENTROPY

HIGH SENSITIVITY

HIGH FALSE POSTIVE RATE

↓

RE-SCANNING

PET SCANS

NEGATIVE BIOPSIES

NEGATIVE SURGERY

LOW SPECIFICITY

INDETERMINATE NODULES:

MALIGNANT OR BENIGN?

RE-SCANNING

PET SCANS

NEGATIVE BIOPSY

WASTES TIME IN THOSE

WHO ACTUALLY HAVE

INTER-READER VARIABILITY (ENTROPY)

VARIABLE RADIOLOGIST SKILL

DICTATION/TERMINOLOGY

CREATES

UNSTRUCTURED DATA

NLP CAN'T READ

INEFFICIENT: TIME AND MONEY AND SURVIVAL WASTED

NO ONE DESERVES TO DIE OF LUNG CANCER