OA17.03. Missed Opportunities for Early Lung Cancer Detection in a Multidisciplinary Thoracic Oncology Clinic Cohort

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Linked screening program, nodule program, and lung cancer databases
## Among patients with lung cancer, three Cohorts: Screened, Unscreened, Ineligible

	Screened N=122 (6%)	Unscreened N= 788 (41%)	Ineligible N=994 (52%)
Age	70 (65 -74)	67 (62 – 73)	72 (63 – 79)
Female	50	46	53
Black race	17%	**30%**	**30%**
Uninsured	0	2%	6%
Never smoked	0	0	**20%**
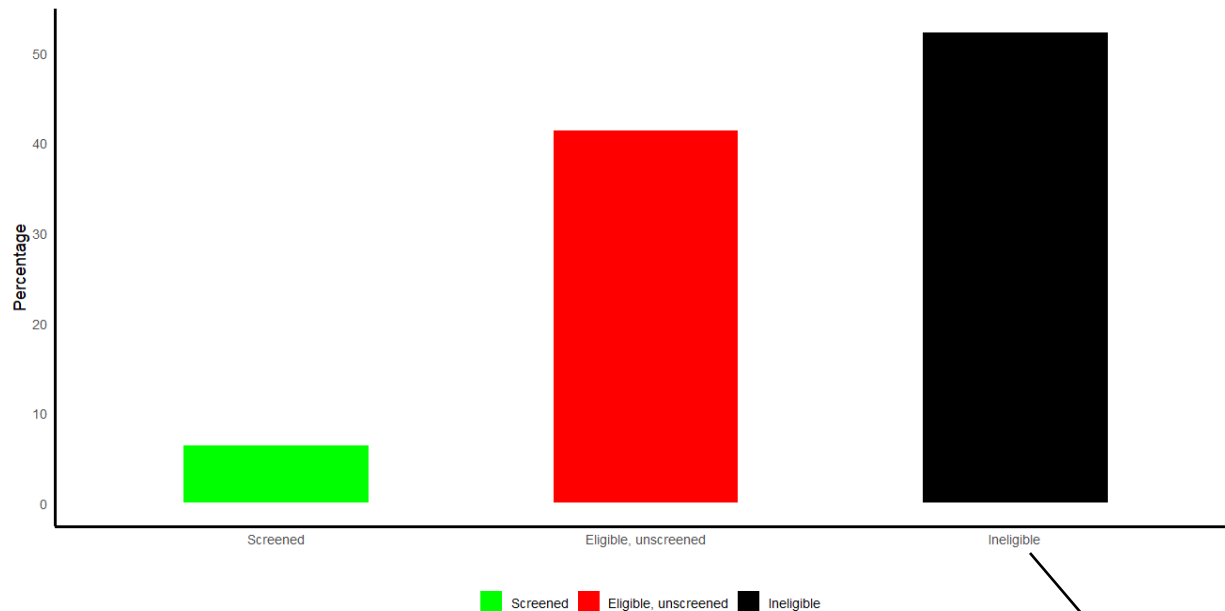
7% age <50 years; 21%>80 years
Of remaining: 20% never smoked, 31% quit >15 years, 14% <20 pack-year history, 35% missing data

- Only 6% of persons diagnosed with lung cancer were screened.
- Mismatch between eligibility criteria and true lung cancer risk was the bigger barrier (52% v 41%).

# Clinical Stage, Treatment, Survival: 3 Cohorts
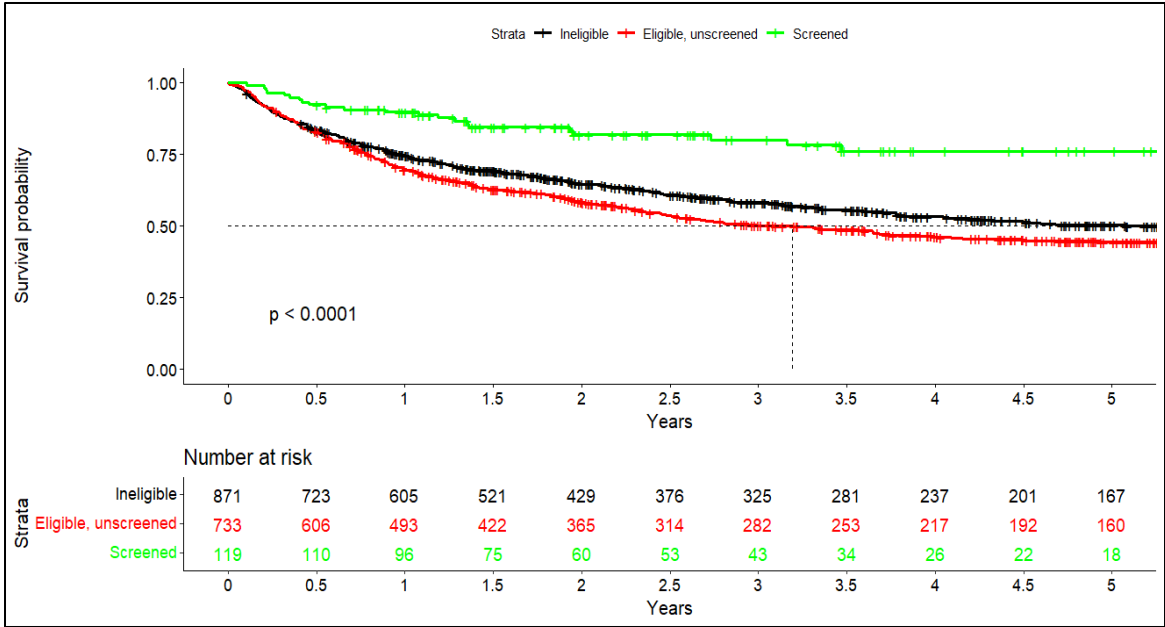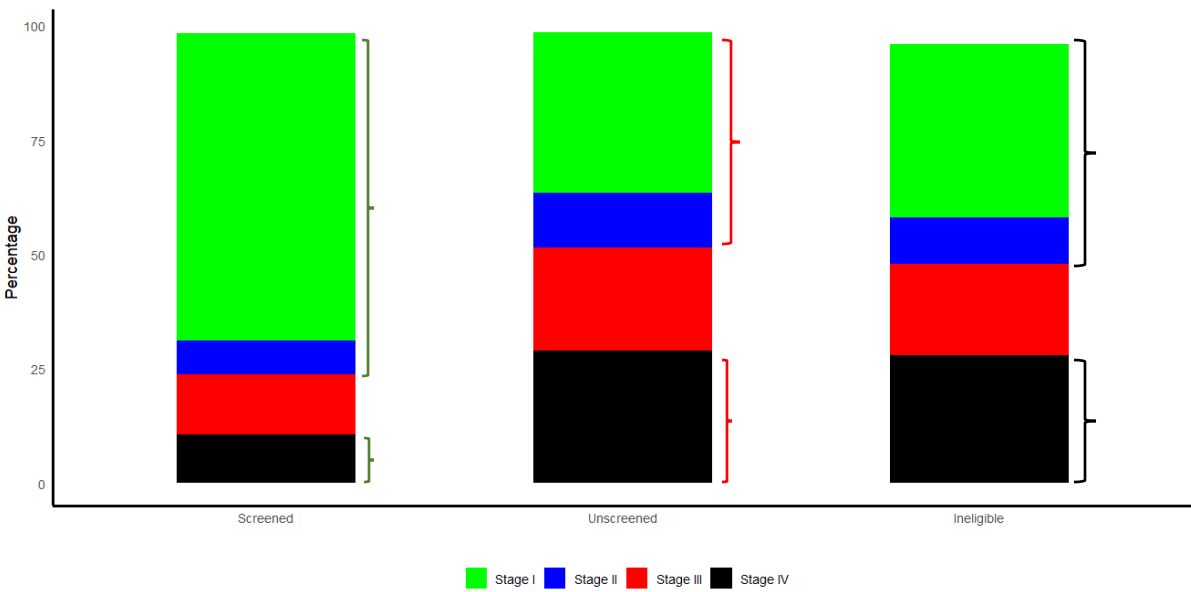
- A third of the eligible unscreened had clinical encounters 1 to 3 years before diagnosis.
- Stage, surgical resection rates, and survival better among the screened
- The nodule program rescued patients from **_both_** barriers.

	Screened	Unscreened	Ineligible
5-year OS	77% (68 -87)	45% (41 - 49)	50% (46 – 54)
aHR*	0.36 (0.23 – 0.54)	Ref	0.87 (0.75 – 1.01)

*Sex, age, race, insurance, Charlson comorbidity index in Cox model

Aggregate US lung cancer survival rate: 25%
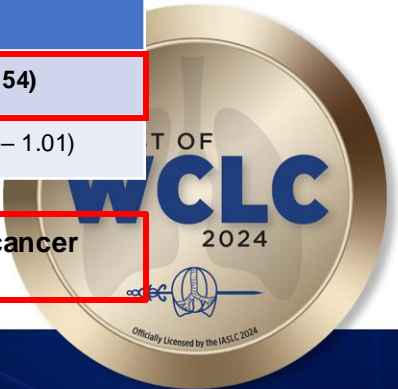
OA.17- Abstract #3092

Implementation of a Natural Language Processing (NLP) Model to Detect Incidental Lung Nodules in a Nationwide Health Care Network

Gabriel Santiago[1], MD, Clarissa Baldotto, MD, PhD[1] , Bruno Hochhegger, MD, PhD[1], Rosana Rodrigues, MD, PhD[1], Tiago Machuca, MD, PhD[1], Karina Martinez[1], Evelise Zaidan[1], Marco Conrado, MD[1]

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PESQUISA E ENSINO
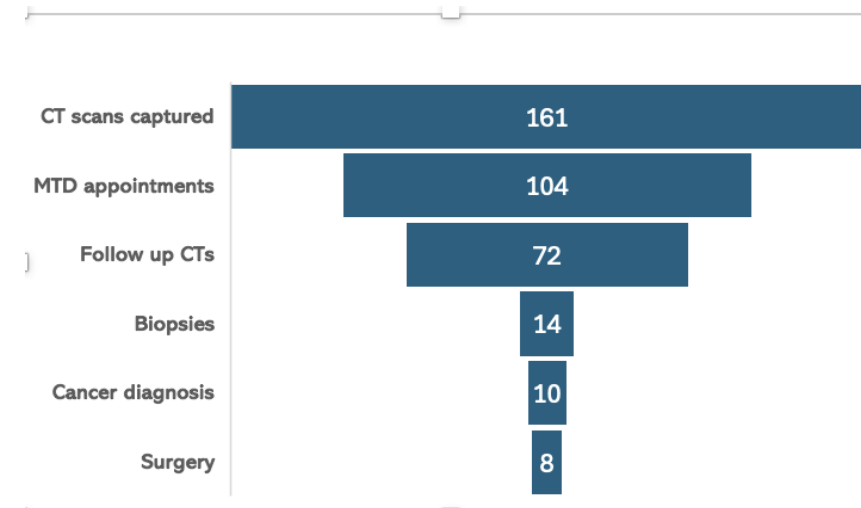
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METHODS

- The objective of this study was to implement the ILN detection NLP model in clinical practice and evaluate its applicability for lung cancer screening.

- A clinical care pathway was developed and implemented, connected to the data generated by the AI with the goal of improving patient management.
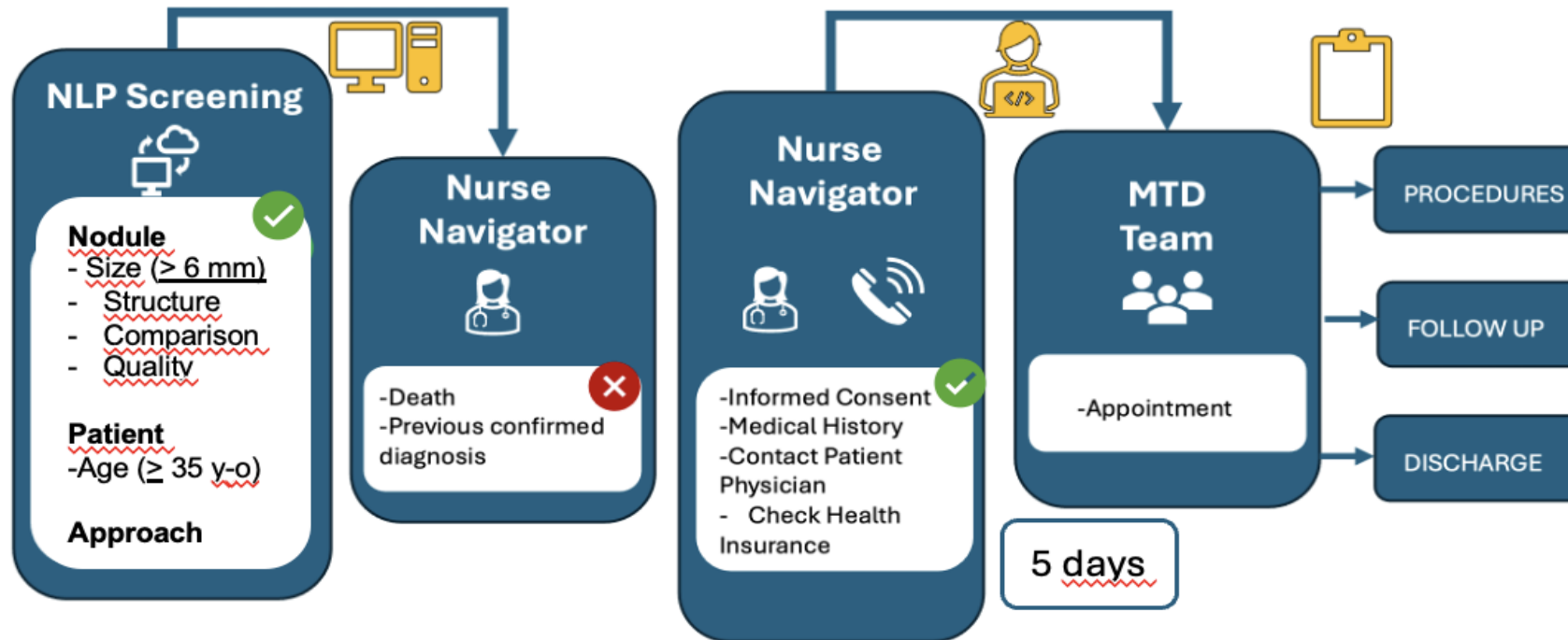
RESULTS

- The National program evaluated a total of 67,599 chest CT reports, and 1,212 cases **(1.79%)** were identified for follow-up investigation.

CT criteria	National database		AF Hospital	
All CT reports	67,599	100.0%	11,108	100.0%
Nodule on report	31,854	47.1%	4,366	39.3%
Nodule selected by size and shape	3,261	4.8%	320	2.9%
NLP recommendation for follow up	1,212	1.8%	**161**	**1.4%**

CT scans captured — 161
MTD appointments — 104
Follow up CTs — 72
Biopsies — 14
Cancer diagnosis — 10
Surgery — 8

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2024 World Conference on Lung Cancer

SEPTEMBER 7-10, 2024 | SAN DIEGO, CA USA

A Randomized Controlled Trial of a Digital Lung Health Intervention to Facilitate Smoking Cessation and Lung Cancer Screening

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USA

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55-77yo smokers with at least 30 pack-years

Enhanced Smoking Cessation Approach to Promote Empowerment (ESCAPE) digital intervention

- Counseling and combined NRT
- Storytelling narrative communication messages
- Educational materials used as part of the intervention
  - Patient participant
    - Lung cancer screening decision aide
  - Primary care provider
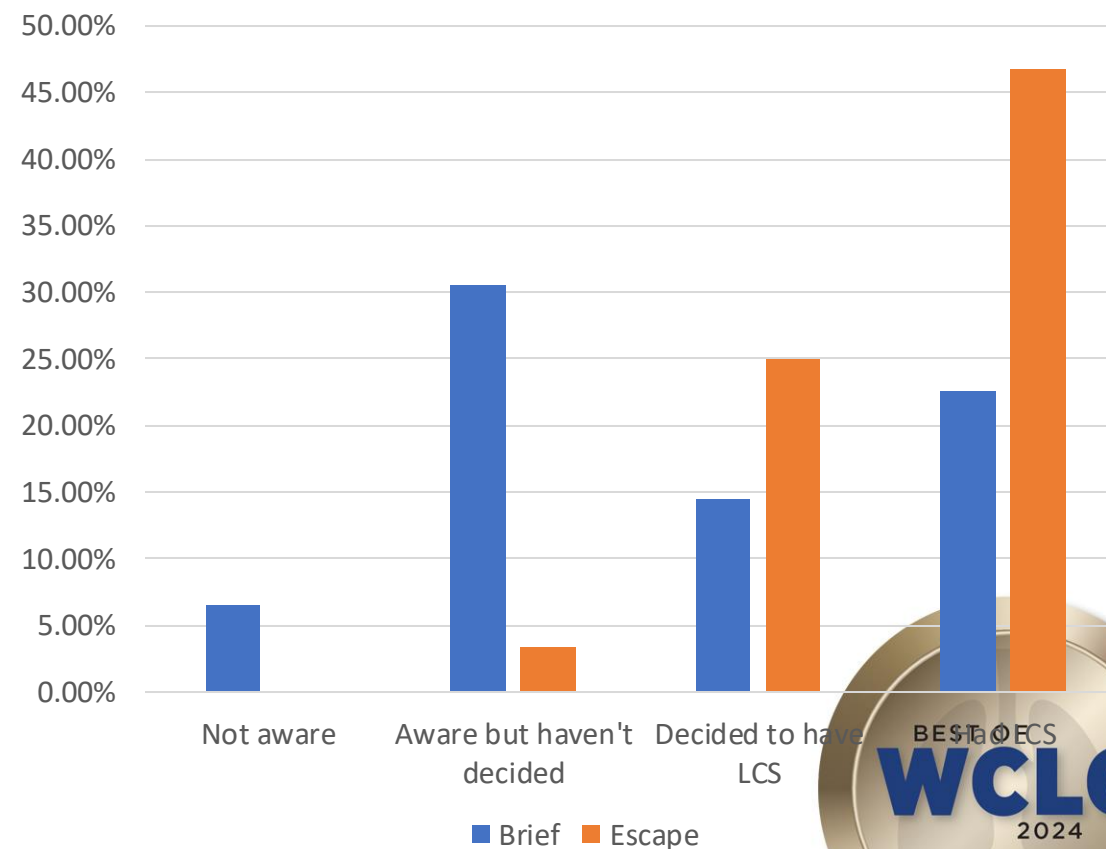   - CMS lung cancer screening Checklist

BRIEF

- Advice to quit smoking
- Referral to state Quitline to provide counseling and NRT
- Educational materials
  - Patient participant
    - Lung cancer screening decision aide

Smoking Cessation 7 and 30 Day PPA
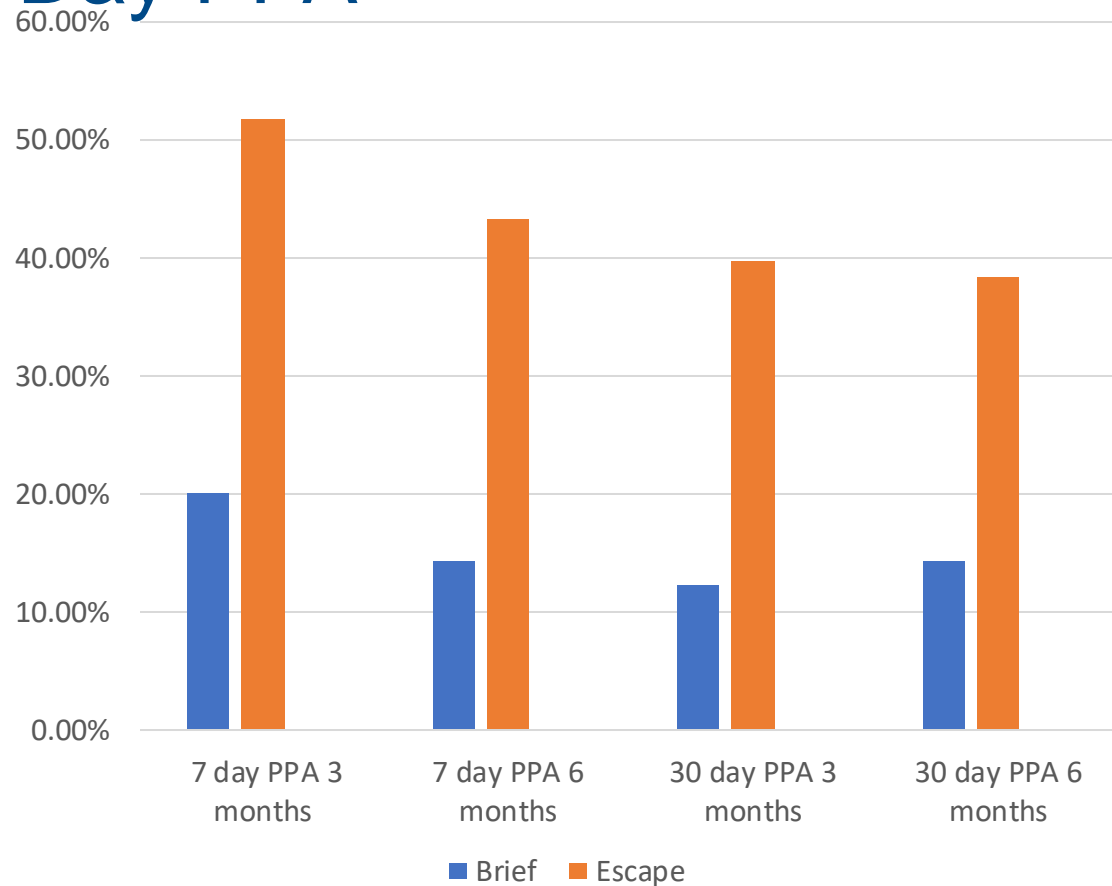
Lung Cancer Screening Adoption at 6 months

Impact of Using Smoking Duration in Place of Pack-Years as Eligibility Criteria for Lung Cancer Screening to Reduce Racial and Ethnic Disparities

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Christopher A. Haiman, PhD, Sung-Shim Lani Park, PhD, Joel W. Neal, MD, Rafael Meza, PhD,
Martin C. Tammemägi, PhD, Iona Cheng, PhD, Loïc Le Marchand, MD, Heather A. Wakelee, MD,
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*equal contribution, ** equal contribution

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Study Goals and Methods

Goal 1: Compare smoking duration-based USPSTF guidelines vs. risk-based screening

Eligibility criteria compared

USPSTF 2021 Guidelines (USPSTF-21)	vs	Smoking duration in USPSTF-21 (duration-based criteria)	vs	PLCOm2012-Update (risk-based criteria)

Goal 2: Evaluate eligibility rate in context of lung cancer risk by racial and ethnic groups

| Metrics assessed |
|---|
| 1. **Eligibility rate** |
| 2. **Eligibility-incidence ratio** (E-I ratio; 6-year lung cancer incidence) |
| 3. **Screening performance** (sensitivity, specificity, number needed to screen [NNS]) |

Results: USPSTF-21 vs. Duration-based

Screening performance	USPSTF-21	>30y duration	>20y duration	>10y duration
Eligibility rate (%)	24.0	27.5	40.5	48.6
Sensitivity (%)	57.7	66.1	76.2	81.2
Specificity (%)	76.5	73.0	60.0	51.9
NNS	30	30	39	44

- **>30-year smoking duration threshold:**
  - Closest match to USPSTF-21 eligibility rate
  - Increased sensitivity
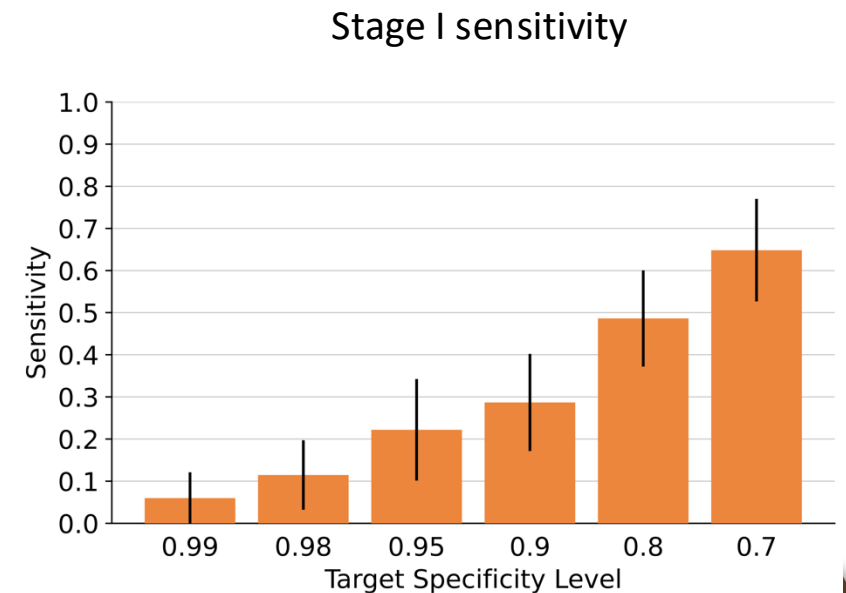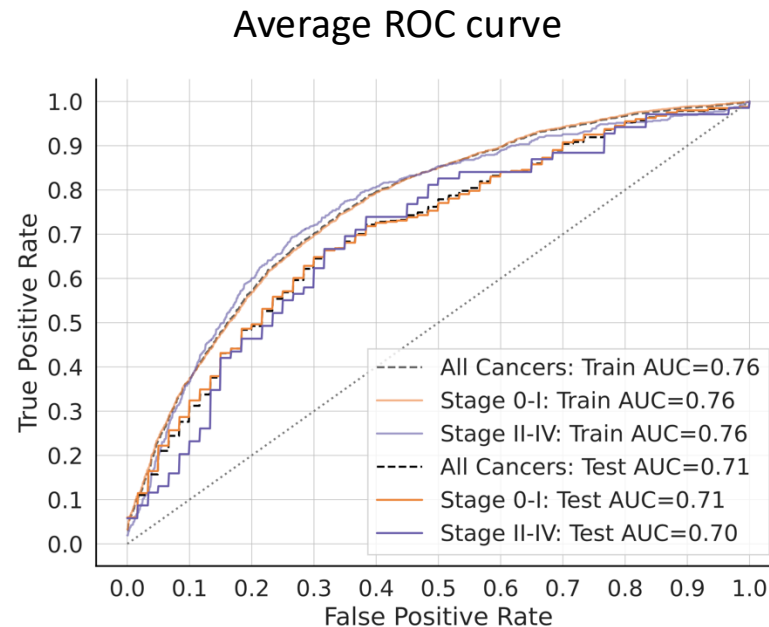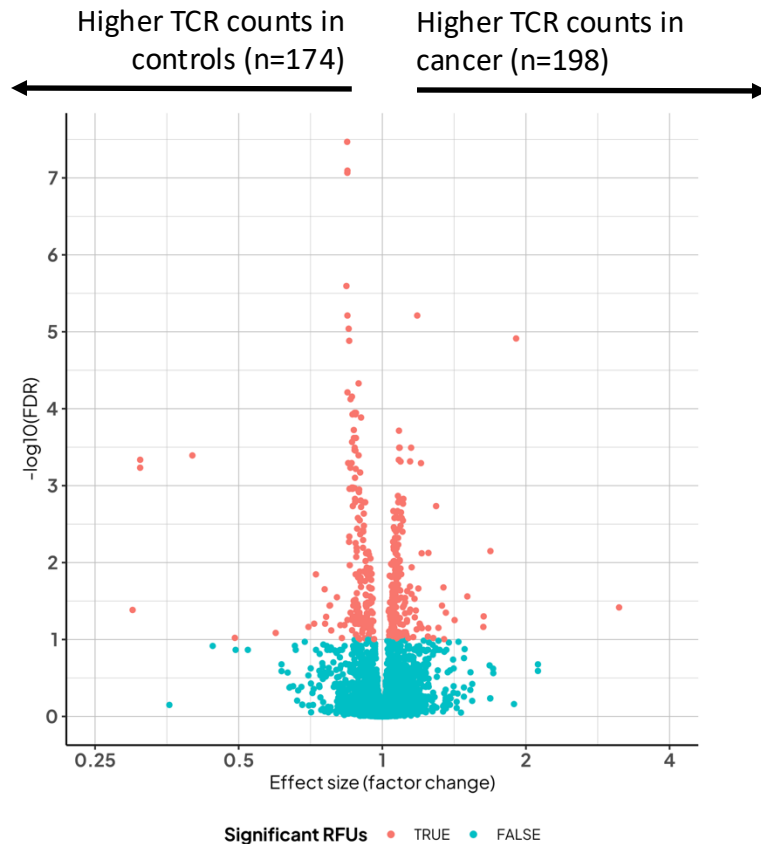 - Little compromise in specificity
  - No change in NNN

E–I ratio

Disparity in E–I ratio
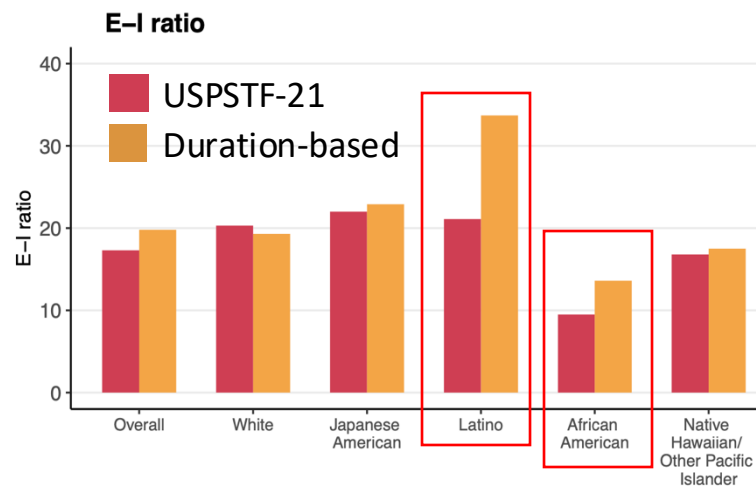
Disparity in E-I ratio was reduced from 53.2% to 29.5% among African American individuals
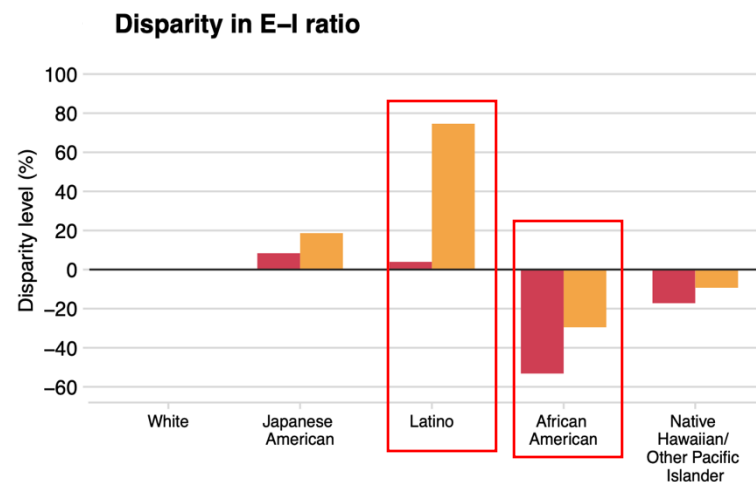
But with potential over-screening among Latino individuals

We identified 372 TCR RFUs that can be used to detect lung cancer through liquid biopsy

Higher TCR counts in controls (n=174)

Higher TCR counts in cancer (n=198)

Average ROC curve

All Cancers: Train AUC=0.76
Stage 0-I: Train AUC=0.76
Stage II-IV: Train AUC=0.76
All Cancers: Test AUC=0.71
Stage 0-I: Test AUC=0.71
Stage II-IV: Test AUC=0.70

Significant RFUs • TRUE • FALSE

Stage I sensitivity

Data from SVM model, linear kernel, with bagging. Showing average 10-fold cross-validation (CV) performance of full RFU discovery process inclusive of nearest neighbor graph construction and clustering.

Blood microRNA detection in lung cancer screening eligible individuals
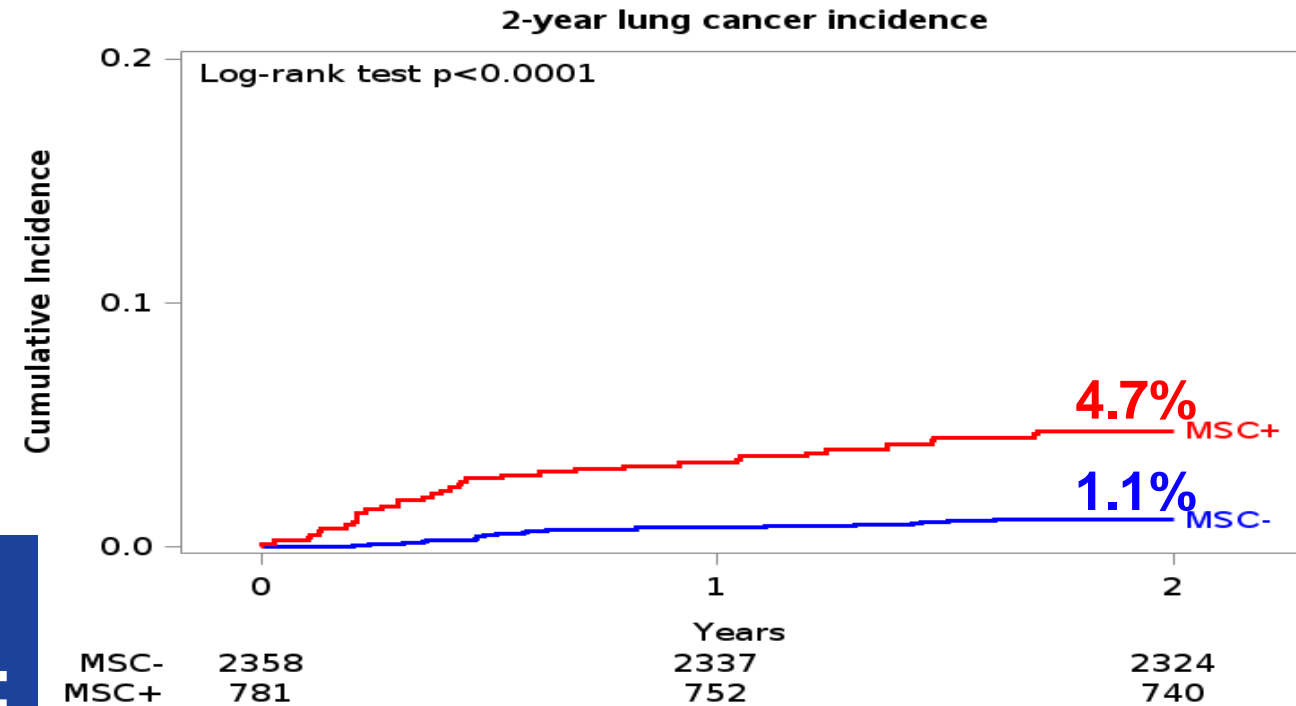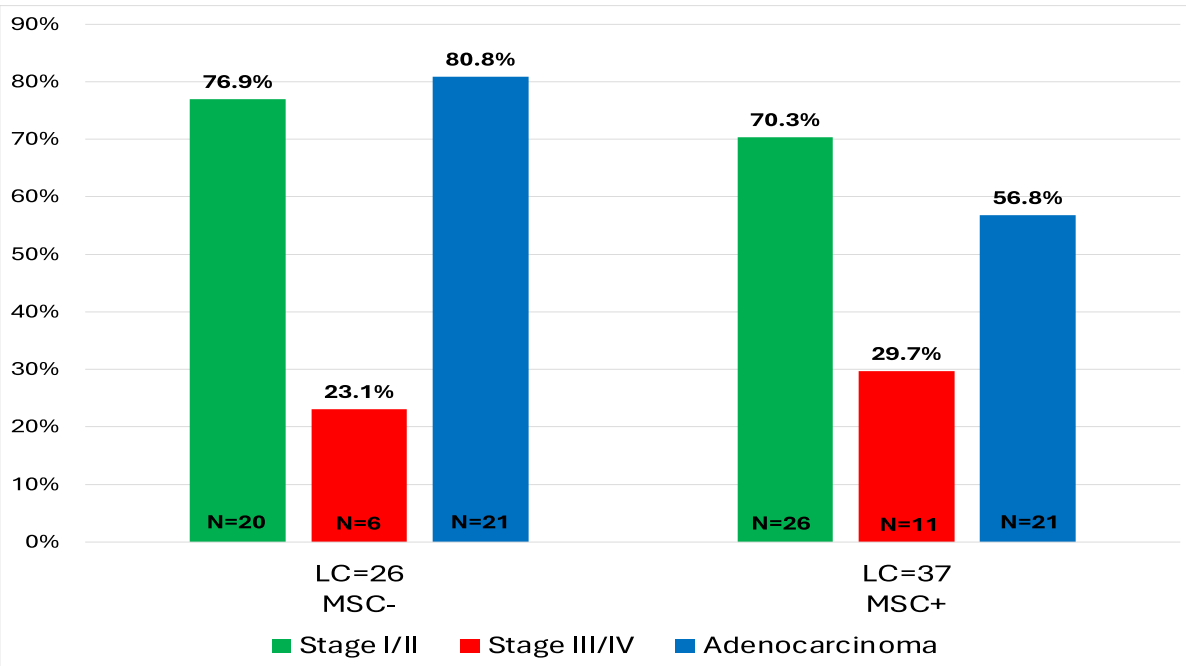
MSC in LCS eligible:
Sensitivity 58.7%, 56.5% stage I-II;
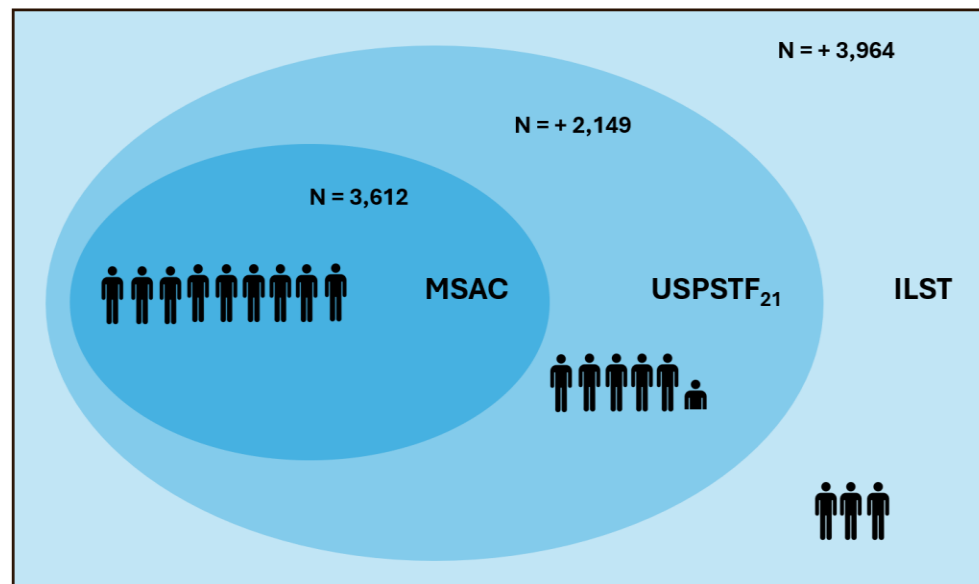**Specificity: 75.8%**

Australia – Proposed Medical Services Advisory Committee (MSAC) criteria 2025 50-70yo, 30pack-years, <=10years quit date

N = + 3,964

N = + 2,149

N = 3,612

MSAC   USPSTF$_{21}$ ILST

Total Participants: **9,725**
Total LC cases: **173**

= 10 LC cases

- **The proposed MSAC criteria lacks sensitivity, compared to other lung cancer screening selection criteria**
- **Continuing evaluation of MSAC optimal selection criteria for the Australian NLCSP will be required after establishment in 2025.**

	PLCOm2012	LLPv2	USPSTF2021	MSAC
Lung Cancer Cases (%, N)	**92%** (159)	**78%** (134)	**83%** (143)	**52% (90)**
Sensitivity (95% CI)	**0.92** (0.87 – 0.96)	**0.77** (0.70 – 0.83)	**0.83** (0.76 – 0.88)	**0.52 (0.44 – 0.60)**
Specificity (95% CI)	**0.47** (0.46 – 0.48)	**0.52** (0.51 – 0.53)	**0.41** (0.40 – 0.42)	**0.63** (0.62 – 0.64)

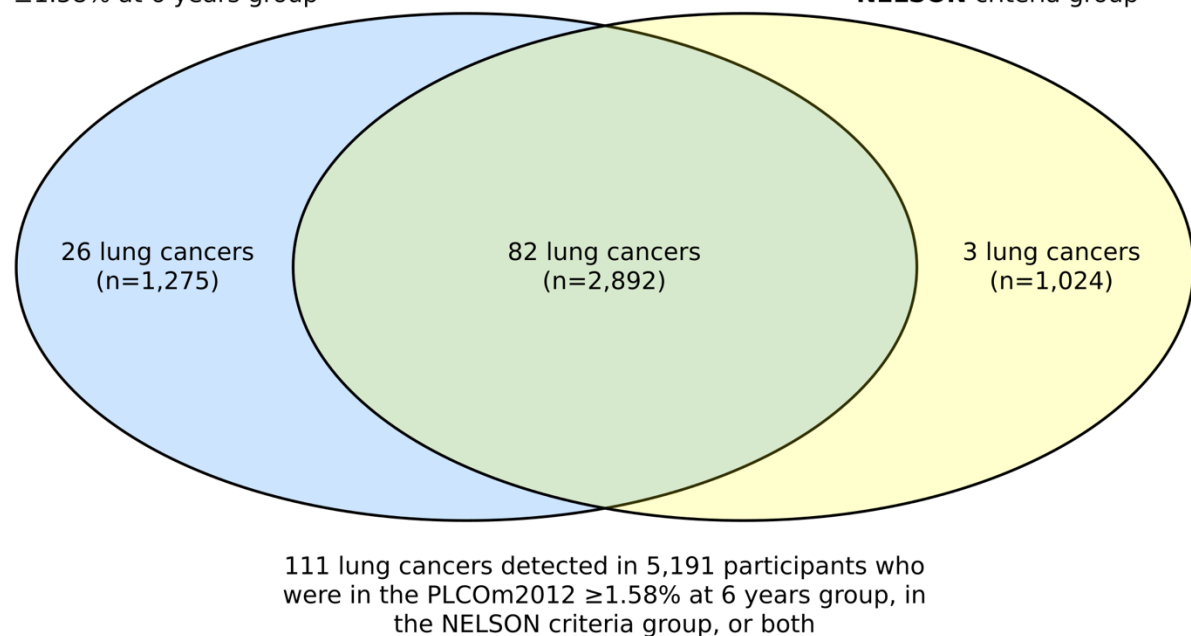Alberta Cancer Registry – Stage I-II lung cancer 2010-2020 (N=6,401)
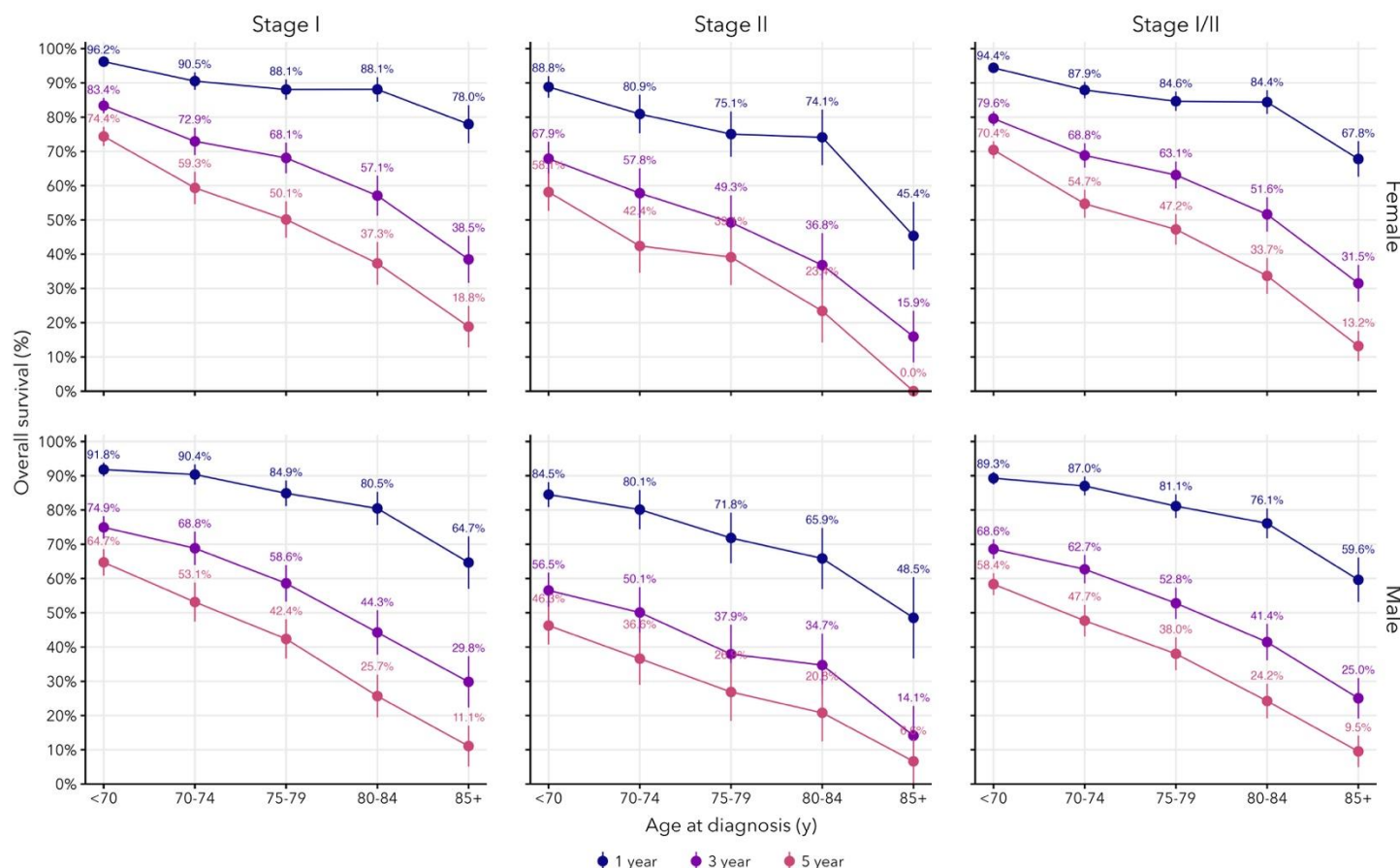
- Some older patients have reasonable survival and may still benefit from screening despite being ineligible according to most guidelines
- Upper age limits to lung cancer screening should consider comorbidity and fitness for surgery since these can significantly influence the survival benefit derived from early detection

Germany – HANSE Study

- **PLCOm2012 @≥1.58 (6y)is reliable and more efficient** than the NELSON criteria for selecting individuals to be enrolled into a lung cancer-screening program.

108 lung cancers detected in 4,167 participants in the **PLCOm2012** ≥1.58% at 6 years group

85 lung cancers detected in 3,916 participants in the **NELSON** criteria group

26 lung cancers (n=1,275)

82 lung cancers (n=2,892)

3 lung cancers (n=1,024)

111 lung cancers detected in 5,191 participants who were in the PLCOm2012 ≥1.58% at 6 years group, in the NELSON criteria group, or both

	NELSON-selected (n=3.916)	PLCOm2012-selected (n=4.167)	p value
Cancer detection rate	**85/111 (76.6%)**	**108/111 (97.3%)**	0,000044
Positive predictive value	**85/3916 (2.17%)**	**108/4167 (2.59%)**	0,004212
Number needed to screen	**46,07**	**38,58**	0,004212
Cancer detection rate‡	85/140 (**60.7%**;52.1%-68.85%)	108/140 (**77.1%**;69.3%-83.8%)	0,000044

‡Statistics partly use data supplemented by PLCO trial estimates with PLCO data for NELSON-negative and PLCOm2012 risk threshold less than 1.58% at 6 years

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Dana-Farber Cancer Care Equity Program

- 20% underwent LC screening despite being referred for another medical reason (Referrals)

- Following their consult, 80% of patients had a radiology test ordered
    - Low-dose CT scan (LDCT: 79%)
    - Standard chest CT scan (21%)*

- LDCT scans were ordered for 87% of the patients who smoked ≥20 cigarettes daily (mean smoking time: 41 years), including for 80% (n=56) of active tobacco users

85% of patients completed their FIRST lung cancer screening

3 of the 101 patients were diagnosed with lung cancer

CISNET MIchiganLUNG model

- Data Envelopment Analysis

- Screening stop age of 80 efficient for Black and White populations

- USPSTF 2013 and 2021 ranked higher in efficiency for White than Black populations

- Strategies that were efficient for Black compared to White Americans tended to be those that started screening at **earlier ages** and with **lower minimum pack-year thresholds**

- Race-specific guidelines might be required to maximize the benefits of lung screening across US populations

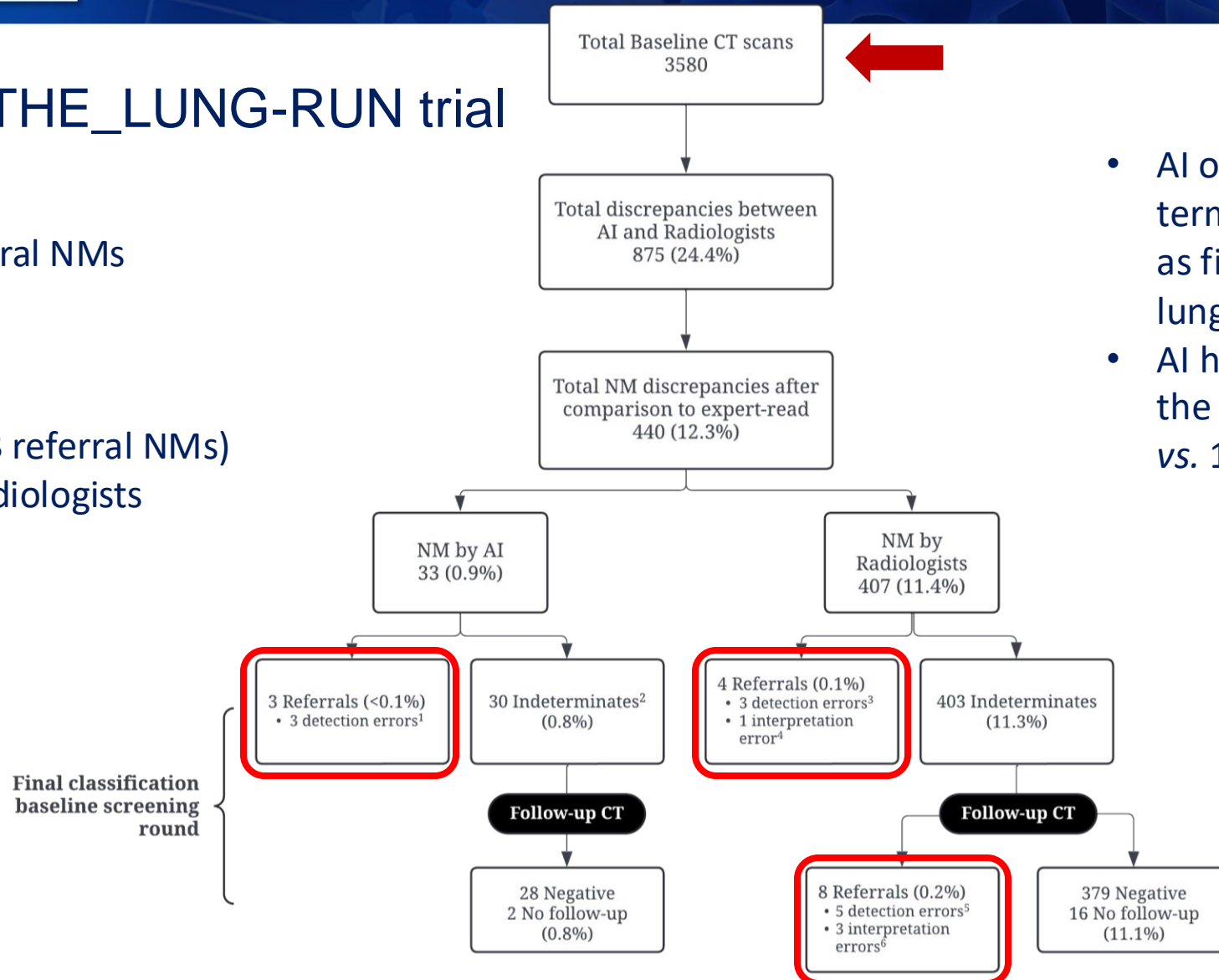- Alternatively, risk-based screening accounting for race differences in risk should be considered

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European 4-IN-THE_LUNG-RUN trial

→ AI 3 referral NMs
→ Radiologists 12 referral NMs

Total of 116 referrals
→ 2.9% missed by AI (3 referral NMs)
→ 12.7% missed by Radiologists
    (12 referral NMs)

Total Baseline CT scans
3580

Total discrepancies between AI and Radiologists
875 (24.4%)

Total NM discrepancies after comparison to expert-read
440 (12.3%)

NM by AI
33 (0.9%)

NM by Radiologists
407 (11.4%)

3 Referrals (<0.1%)
• 3 detection errors[1]

30 Indeterminates[2]
(0.8%)

4 Referrals (0.1%)
• 3 detection errors[3]
• 1 interpretation error[4]

403 Indeterminates
(11.3%)

Final classification baseline screening round

Follow-up CT

Follow-up CT

28 Negative
2 No follow-up
(0.8%)

8 Referrals (0.2%)
• 5 detection errors[5]
• 3 interpretation errors[6]

379 Negative
16 No follow-up
(11.1%)

• AI outperforms radiologists in terms of NMs and therefore as first reader in the 4ITLR lung cancer screening trial
• AI had a 4x lower impact on the clinical referral rate (2.6% *vs.* 10.3%)
    → No increased risk of delayed or missed diagnoses compared to radiologists

iDNA

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Sybil

- **Our data:**

  - 39,861 LDCT images

  - 3,164 LDCT images with confirmed lung cancers

  - From three studies: Pan-Canadian Early Detection of Lung Cancer Study, Pittsburgh Lung Screening Study, and Toronto Lung Screening Program

- **Metric:** Area under the receiving operating characteristics curve (AUC)

- **Outcome:** Risk of developing lung cancer within 1 to 6 years

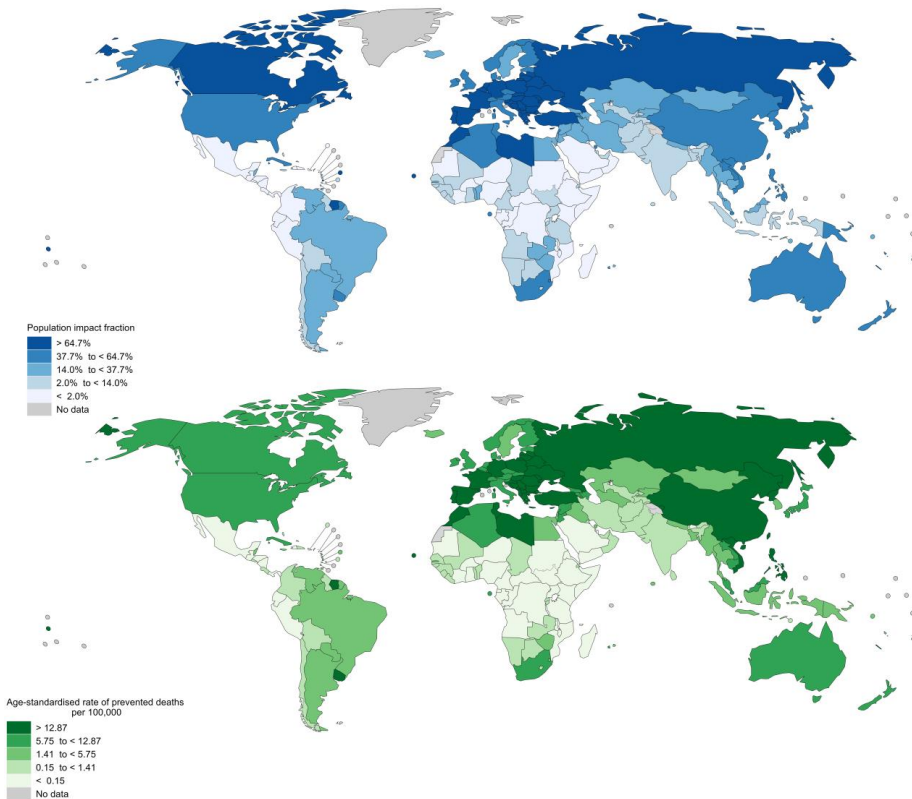- **Stratification:** By nodule diameter and presence
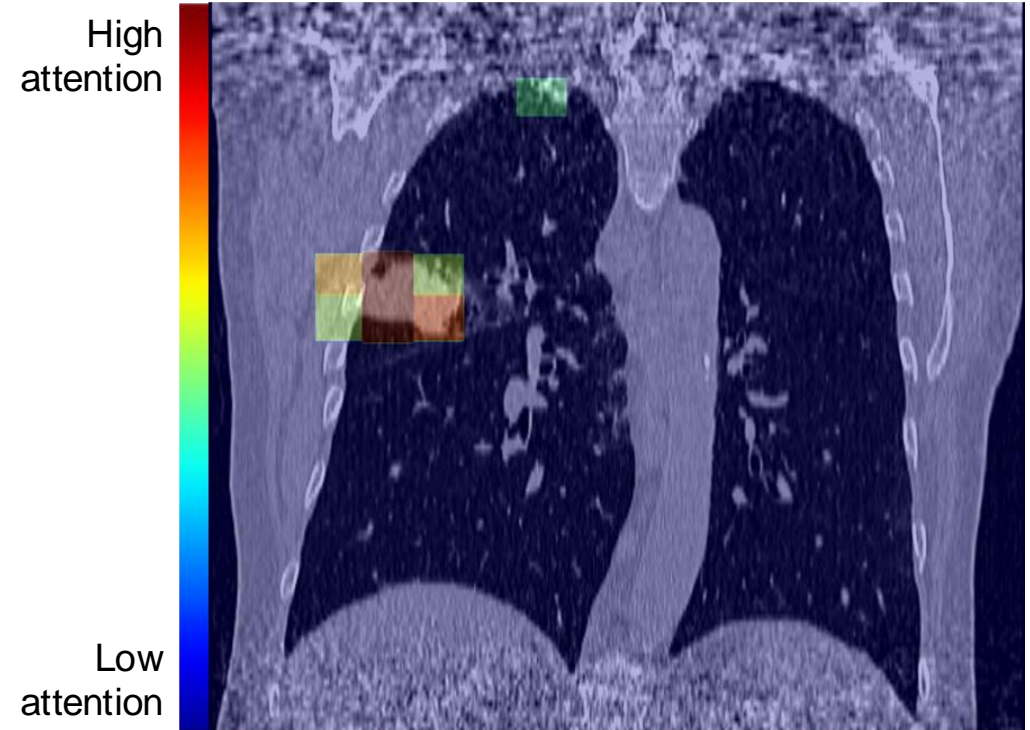
Sybil's attention map of a coronal slice of an LDCT scan.
High attention reflects regions in the image that are given more weight when estimating lung cancer risk.
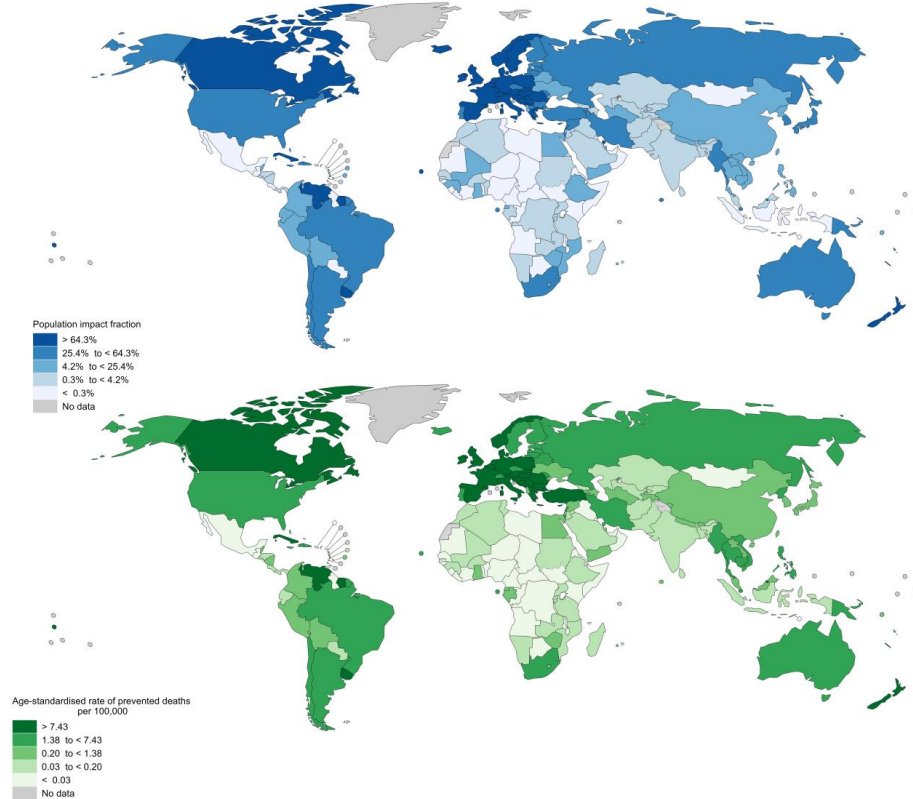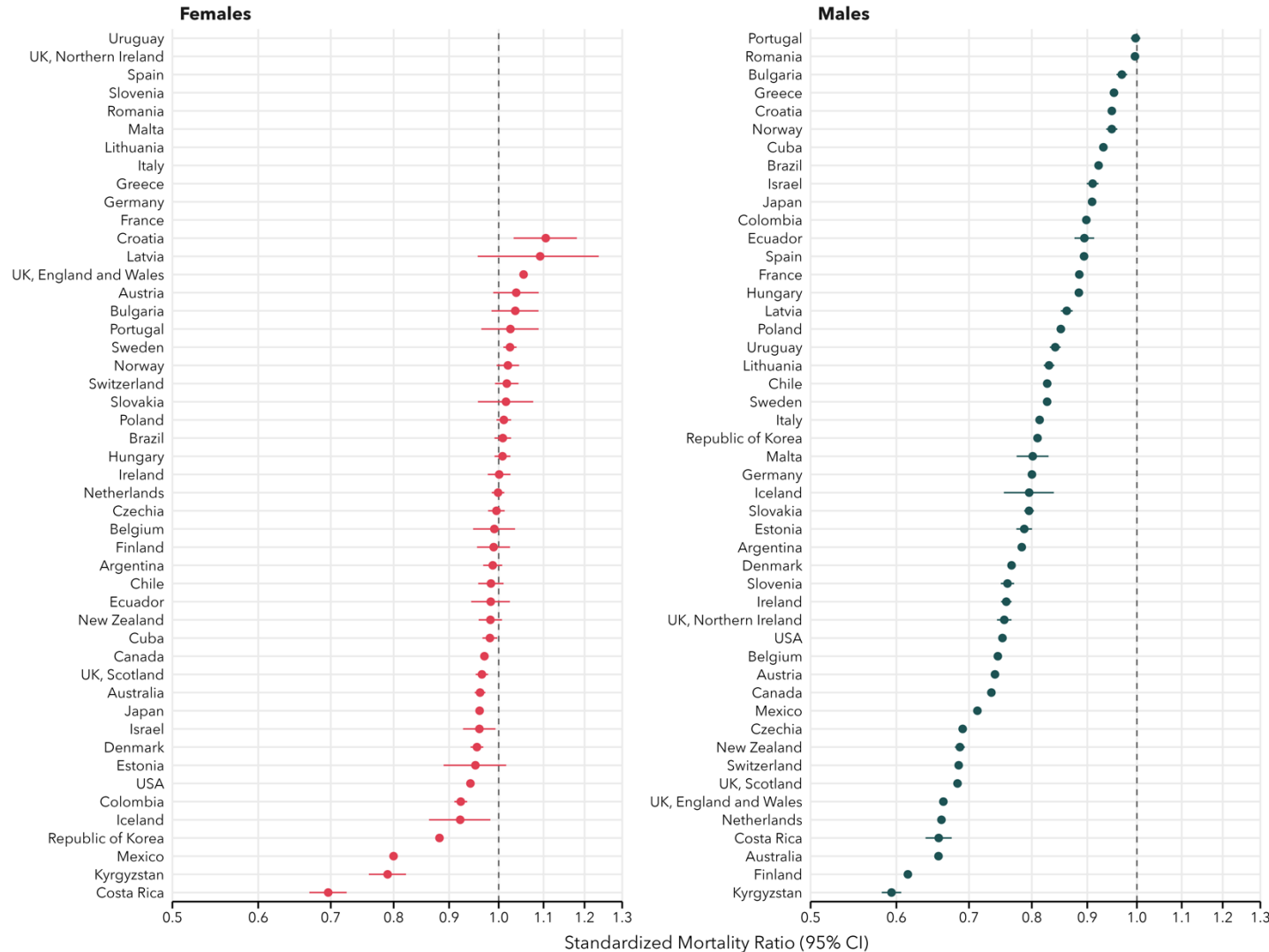
Results

Around 1.2 million lung cancer deaths could be avoided in a 5-year birth cohort in 185 countries if smoking uptake is eliminated.

Men
Women

- There has been a significant reduction in lung cancer deaths for 46 out of 48 (96%) countries for males, but only 14 out of 48 (29%) for females

- Fourteen countries have reduced lung cancer mortality by more than 25% for males, while only one country has achieved this feat for females

- Across all countries, 21.4% and 4.3% of expected lung cancer mortality has been avoided since mortality rates peaked for males and females

Overall Messages

- We must improve screening rates for eligible individuals

- We must refine screening criteria to match lung cancer risk and reduce disparities

- We must harness technology

- Tobacco control remains key to decreasing lung cancer deaths