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UNC Lineberger Comprehensive Cancer Center - Cancer Outcomes Research Program

Implementation of Lung Cancer Screening in Community-based Healthcare Systems: Opportunities and Barriers Associated with the Provision of Equitable Care

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*Major contributors to this presentation.

Presentation Agenda

Overview of Lung Cancer Screening: Why, What and Who

PROSPR-Lung

PROSPR-Lung Findings

Barriers/Opportunities

Lung Cancer Burden in the United States



CASES & DEATHS

2021 235,760 new cases *Ref: SEER Cancer Stat Facts: Lung and bronchus cancer. NCI*
(expected) 131,880 deaths

In the US, lung cancer incidence and mortality rates vary by race, ethnicity, sex, and SES. *Ref: Rivera et al. 2020*

Lung cancer remains the **leading cause of cancer related deaths**, but the *pace of annual decline in overall lung cancer mortality* doubled from **2.4% in 2014** through **2018 to 5%**.

Ref: Siegel et al, 2021

Consistent with declines in prevalence of smoking, from 2001 to 2018, overall lung cancer **incidence** and **death rates**, in men and women and for all racial and ethnic groups in the United States have declined.

Ref: Islami 2021 & Annual Report to the Nation on the Status of Cancer

\$ COSTS

The explosion of targeted therapies now dominates current increases in the US lung cancer related costs of care.

Ref: Shih et al 2015 & van Boemmel-Wegmann et al, 2021

Using SEER-Medicare data, net annualized patient out-of-pocket costs (\$2019) for medical services for patients diagnosed with lung cancer in the initial and end-of-life phases of care were lowest for patients originally diagnosed with *localized* disease (**\$2238** and **\$2840**, respectively) and compared with *advanced-stage* disease (**\$4567** and **\$4756**, respectively).

Ref: Yabroff et al 2021 & Annual Report to the Nation on the Status of Cancer



Why Screen For Lung Cancer?

Decreased Mortality

	Setting	Population	Key Findings
NLST ¹ - RCT vs CXR	United States 33 Centers	<ul style="list-style-type: none">■ 53,454 people■ old USPSTF criteria	<ul style="list-style-type: none">• Lung cancer screening with LDCT reduced the risk of dying from lung cancer by 16-20% and all cause mortality by 6.7%• NNS to prevent 1 LC death 303-320
NELSON ² trial- RCT vs Usual Care	Netherlands/Belgium	<ul style="list-style-type: none">■ 13,195 men & 2,594 women■ less pack year requirement	<ul style="list-style-type: none">• 24% reduction in lung cancer mortality for men• 33% reduction in lung cancer mortality for women during a 10-year follow-up study• NNS to prevent 1 LC death 103
Recent meta-analysis presented at IASLC ³	9 RCTs	<ul style="list-style-type: none">■ >96,000 patients	<ul style="list-style-type: none">• Confirmed benefits of LCS showing LDCT 16% relative reduction in mortality vs no screening

¹National Lung Screening Trial Research Team, Aberle DR, Adams AM, Berg CD, et al. Reduced lung-cancer mortality with low-dose computed tomographic screening. N Engl J Med. 2011 Aug 4;365(5):395-409. doi: 10.1056/NEJMoa1102873. Epub 2011 Jun 29.

²de Koning HJ, van der Aalst CM, de Jong PA, et al. Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trial. N Engl J Med. 2020 Feb 6;382(6):503-513. doi: 10.1056/NEJMoa1911793. Epub 2020 Jan 29. PMID: 31995683.

³Field JK, Vulkan D, Davies MP, et al, UKLS trial outcome results: Lung cancer mortality reduction by LDCT screening confirmed in an international meta-analysis. 2021 World Conference on Lung Cancer, Sept. 14, 2021



Lung Cancer Screening Eligibility Guidelines

U.S. Preventive Services Task Force (USPSTF) Guidelines (B recommendation) recommends annual screening with LDCT and smoking cessation counseling for:

	2013 Guidelines	2021 Guidelines
Age	55 to 80 years old	50 to 80 years old
Smoking History	30+ pack-year* smoking history	20+ pack-year* smoking history
Smoking Status	currently smoke or quit within the past 15 years	currently smoke or quit within the past 15 years

*A pack-year is smoking an average of one pack of cigarettes per day for one year. For example, a person could have a 20 pack-year history by smoking one pack a day for 20 years or two packs a day for 10 years.



Unique Aspects of Lung Cancer Screening

- USPSTF Recommendation B (not A)
 - Uncertainties exist if NLST findings will hold
- Eligibility requirements differ from other cancer screening
 - Age (50-80)
 - Smoking status (e.g. pack-years, quit date, etc.) which is often missing and/or difficult to ascertain
- CMS payment coverage/regulations differs from USPSTF recommendations
 - Age ceiling
 - Fee-for-Service Medicare/Medicaid Providers must submit LCS data to ACR registry
- CMS requires:
 - evidence of Shared Decision Making (SDM) at the initial order or screen
 - smoking cessation counseling for current smokers
- Complicated workflows from initial primary care or pulmonology visit to follow-up management
 - Follow-up depends on reading radiologist's Lung-RADS assignment



Lung-RADS 1.1* Assessment Categories

Post Baseline Screen

Definition of adherence to Lung-RADS recommendations: annual screening until age out or smoking eligibility expires for those with a negative scan

Lung-RADS Score	Category Descriptor	Findings (mm)*	Management	Malig. Risk	
1	Negative	No nodules	Continue annual 12-month LDCT	<1%	Negative
2	Benign appearance	Some small nodules present (or <30 non-solid)	Continue annual 12-month LDCT	<1%	
3	Probably Benign	Solid ≥ 6 to <8, Part-solid ≥ 6 or new, or GGN >30, etc	6-month LDCT	1-2%	Positive
4A	Suspicious	Solid ≥ 8 to <15, Part-solid ≥ 6 with new or growing, or endobronchial, etc	3-month LDCT; or PET/CT for ≥ 8 mm solid component	5-15%	
4B	Very Suspicious	Solid ≥ 15 , Part-solid ≥ 8 with new or growing, etc	Chest CT with w/o contrast; PET or other diagnostic work-up	>15%	
4X	Suspicion of malignancy	Category 3 with additional features			
S	Other incidental findings	non-lung findings		n/a	Non-lung follow-up



*<https://www.acr.org/-/media/ACR/Files/RADS/Lung-RADS/LungRADSAssessmentCategoriesv1-1.pdf>

Lung Cancer Screening

- **LCS uptake remains low**, particularly in underserved populations
 - BRFSS (*Zahan & Eberth 2019*) based estimates ~14%
- American Thoracic Society statement (*Rivera et al, 2020*) addressing disparities in LCS noted
 - State-based variability in insurance coverage & payments for LCS for **Medicaid** recipients marginalizes vulnerable patients, leading to widening of disparities.
 - Barriers to LCS occur at **multiple** levels, including at the patient, provider, and healthcare-system levels and contribute to the inequities in implementation and dissemination of LCS.
 - **Implicit bias** based on sex, race, and ethnicity, and the perception of providers negatively affects communication and patient–provider interactions.
- Community setting LCS results may vary from NLST results
 - Rates of biopsy and complications may be higher
 - False positive rate may be higher
 - Reduction in mortality may be lower



PROSPR-Lung

also known as...



PROSPR-Lung Overview

- This study is part of the 2018 NCI-funded Population-based Research to Optimize the Screening Process (PROSPR) consortium.
https://healthcaresdelivery.cancer.gov/prospr/coordinating_centers.html
- PROSPR-Lung is a multi-institutional consortium that includes researchers with *varied and complementary* expertise in cancer related screening clinical care, epidemiology, economics, statistics, and health services research.
- PROSPR-Lung includes electronic health records (EHR) and administrative data associated with >2,000,000 *insured* individuals, age 35-89 who receive care from one of 5 diverse community-based healthcare systems between **January 1, 2010 and December 31, 2021**.
- The Lung PROSPR Research Center's (PRC) goal is to reduce lung cancer disparities by evaluating Lung Cancer Screening (LCS) related implementation, utilization, and outcomes across five diverse healthcare systems – and to identify feasible interventions to improve the LCS processes



PROSPR-Lung Performance Sites

Disparities Focus: PROSPR-Lung is comprised **of five heterogeneous US healthcare systems** representing diverse populations and communities.

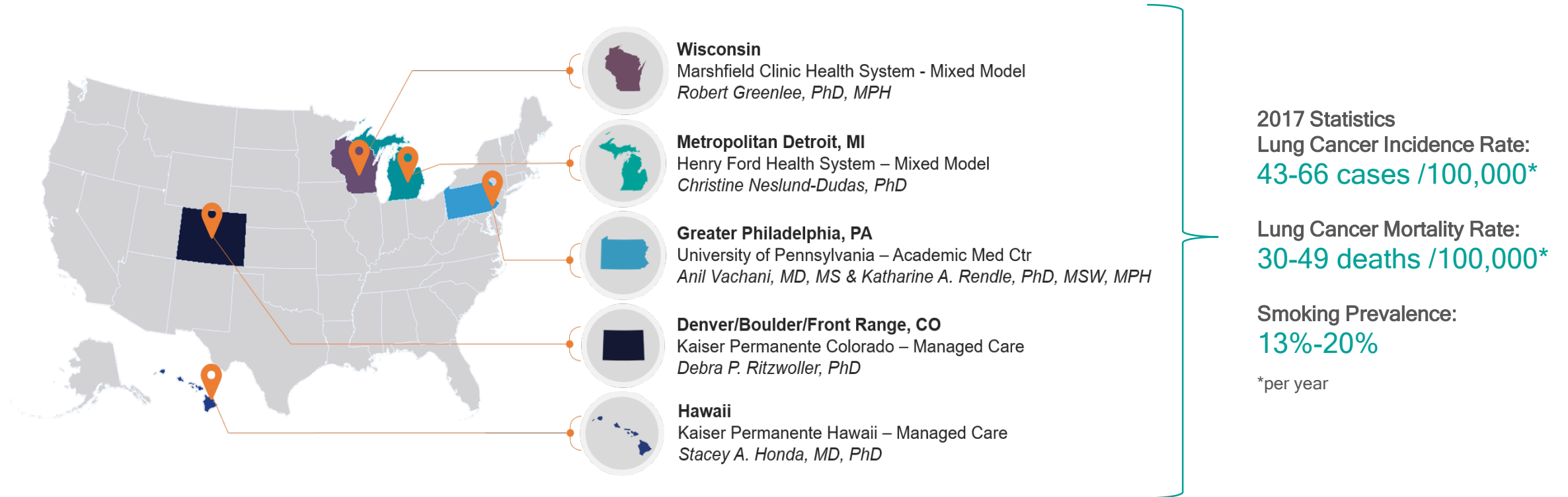
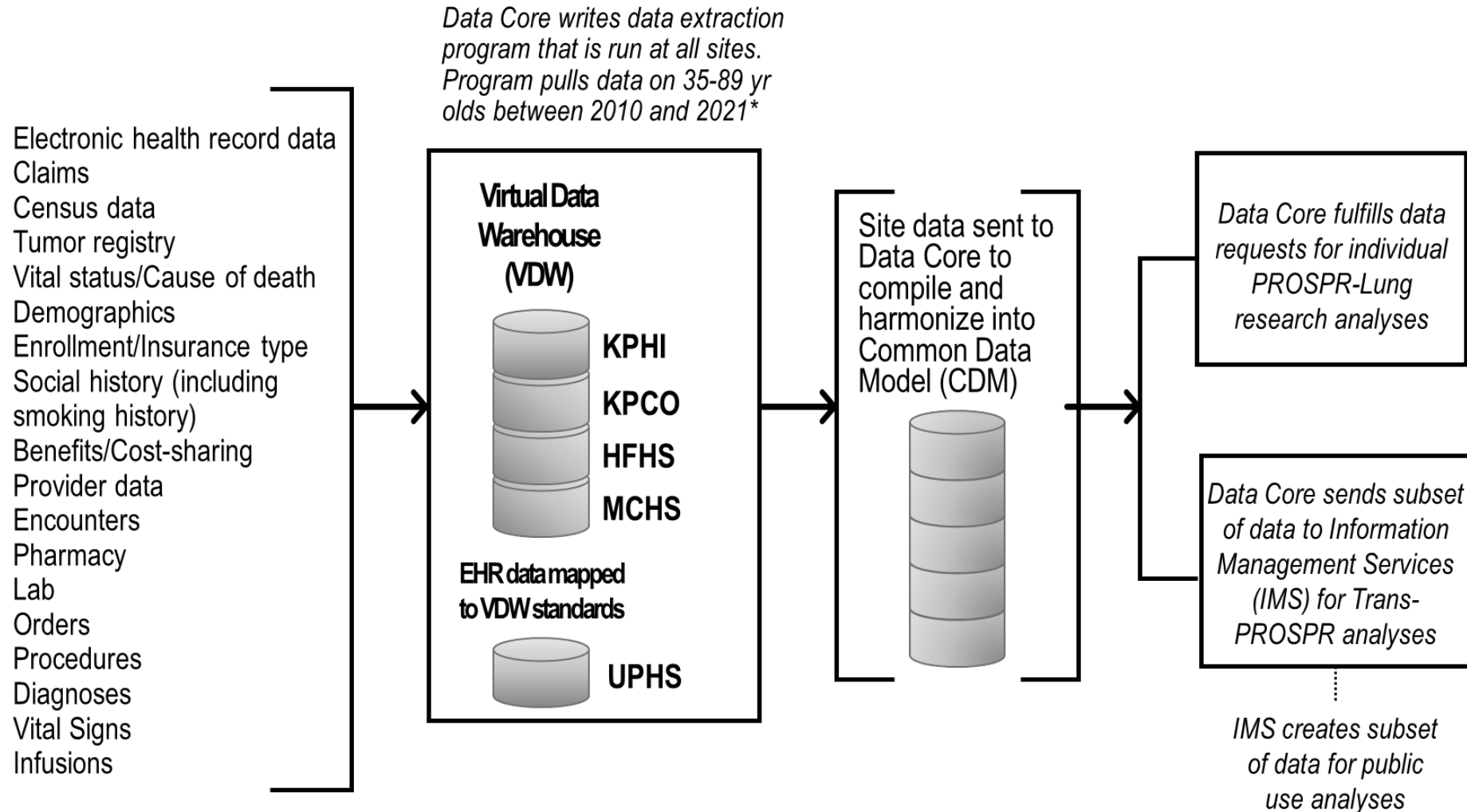


Diagram of PROSPR-Lung Data Acquisition



* Common Data Model V2 is current through September 30, 2019



PROSPR DataShare

- All organ sites required to make a de-identified Public Use Data Set (PUDS) available
- DataShare website in development to facilitate external researcher access to PUDS
- <https://healthcaresdelivery.cancer.gov/prospr/datashare.html>



Lung Cancer Screening Increasing Over Time

18,187

Distinct Patients w/
Baseline/Annual Screen
(G0927, S8032)

30,067

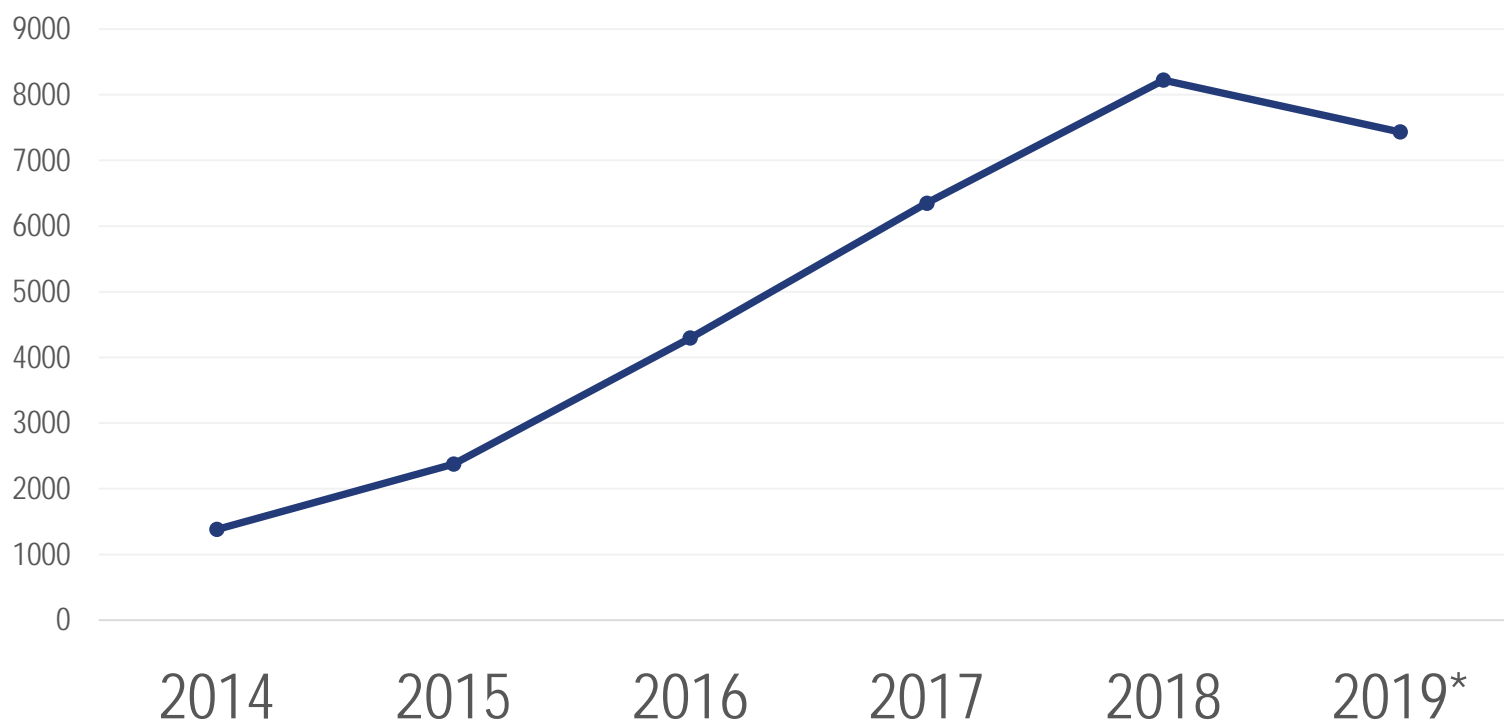
Total Baseline/
Annual Screens

8,569

Total Interval CT Scans
(71250/71260)



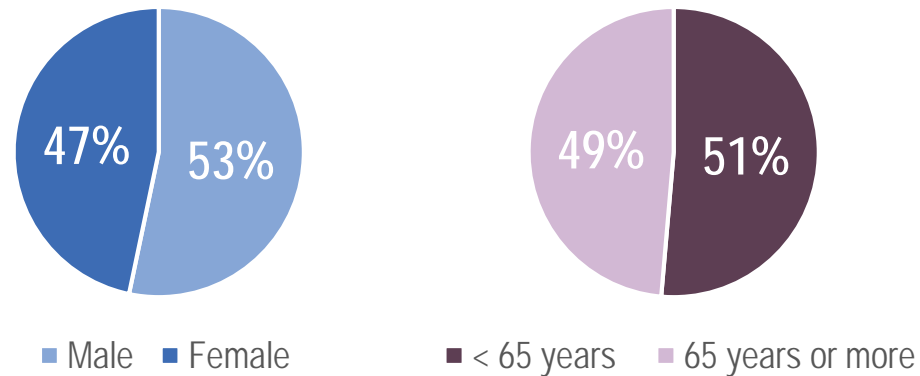
Baseline and Annual Screens
2014-2019*



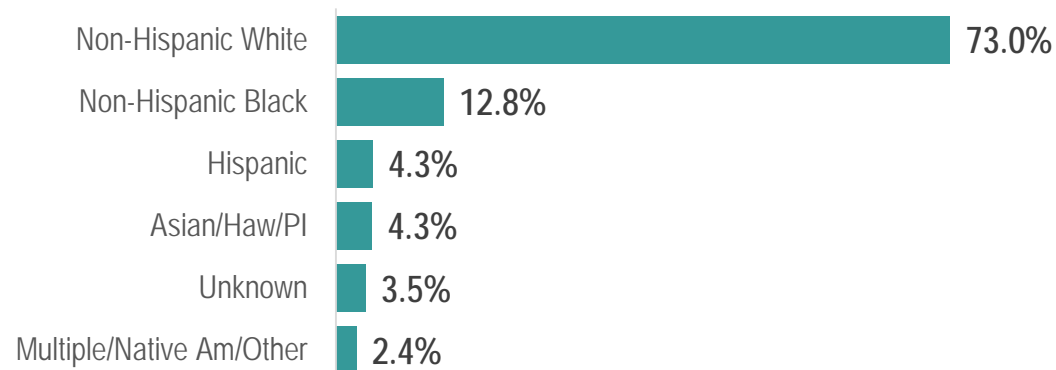
*2019 data through 9/30/2019

Demographics of PROSPR-Lung Patients receiving Lung Cancer Screening

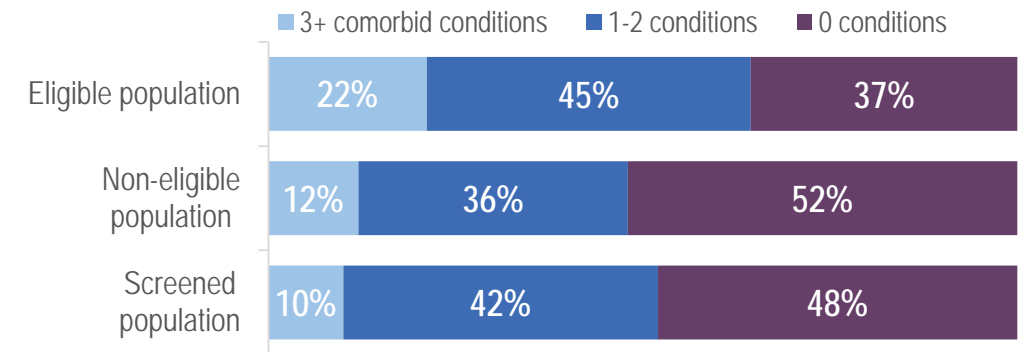
Gender and Age Distribution of Patients receiving Lung Cancer Screening



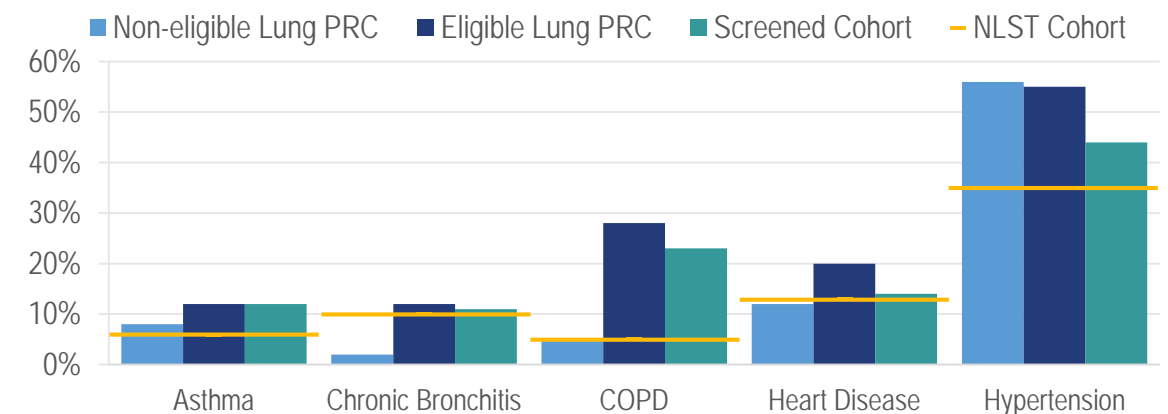
Race/Ethnicity of Patients receiving Lung Cancer Screening



Co-morbidity burden across Lung PRC cohort aged 55-80 yrs



Co-morbidity profile of Lung PRC cohort compared to NLST

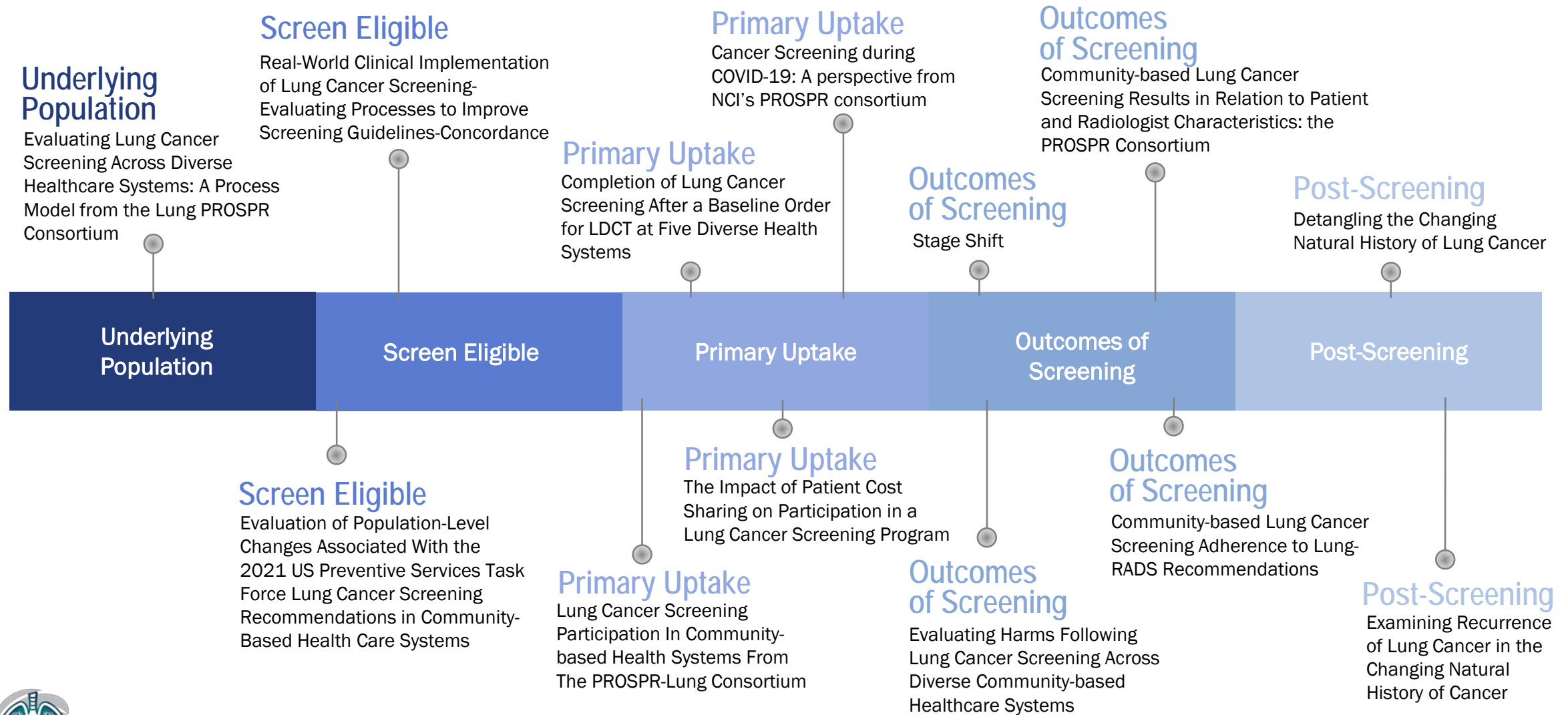




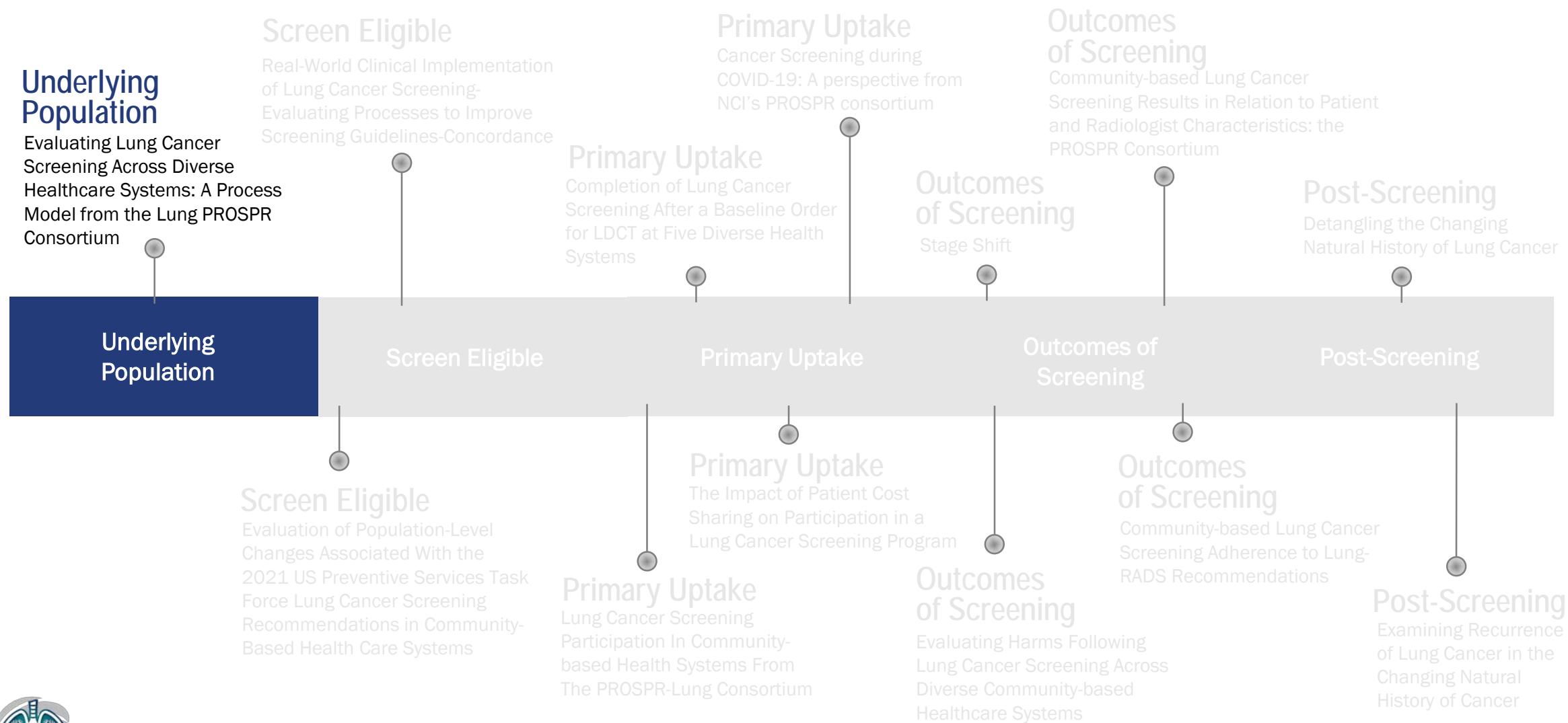
PROSPR-Lung

Overview of recent and current studies and analyses

Continuum of Lung Cancer Screening



Continuum of Lung Cancer Screening

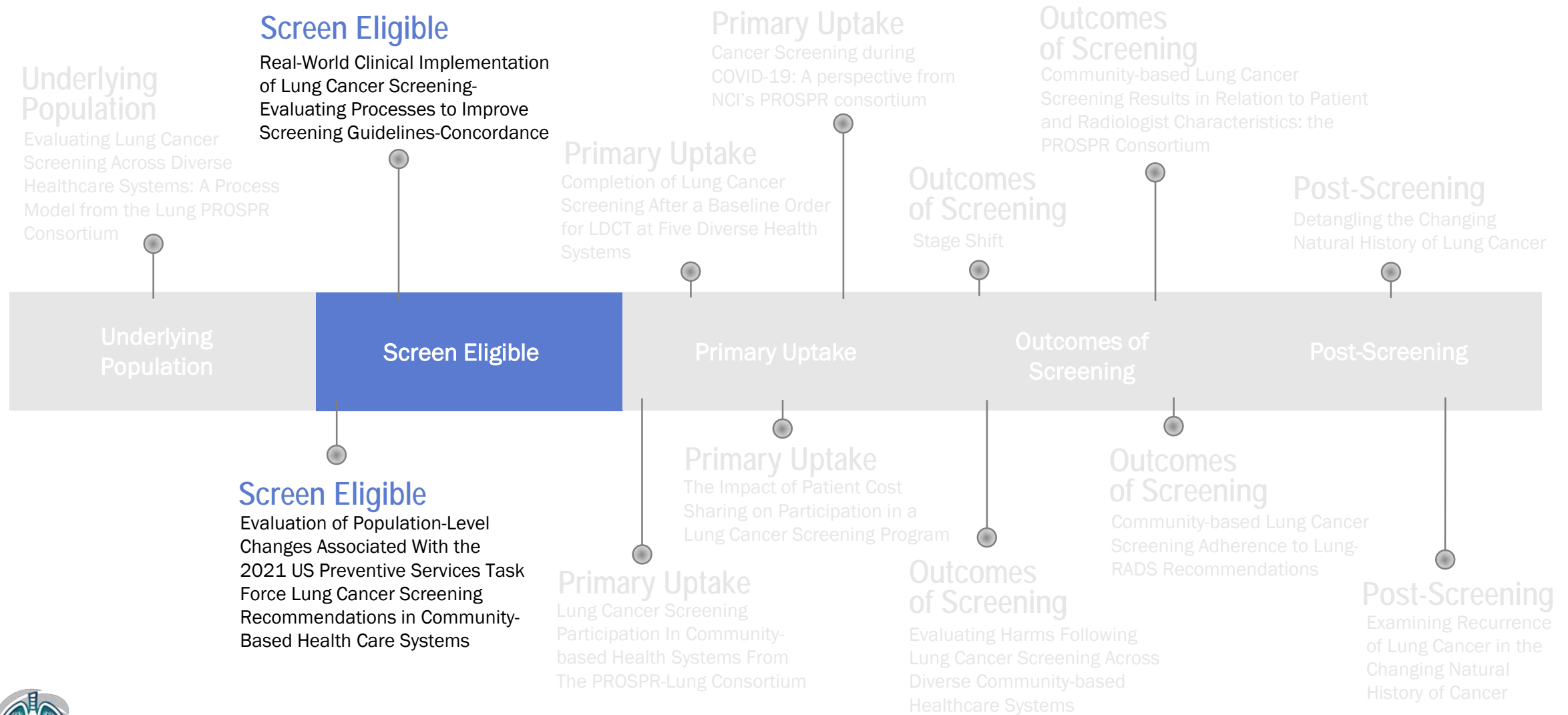


Underlying Population

Evaluating Lung Cancer Screening Across Diverse Healthcare Systems: A Process Model from the Lung PROSPR Consortium

Rendle KA, Burnett-Hartman AN, Neslund-Dudas C, Greenlee RT, Honda S, Elston Lafata J, Marcus PM, Cooley ME, Vachani A, Meza R, Oshiro C, Simoff MJ, Schnall MD, Beaber EF, Doria-Rose VP, Doubeni CA, Ritzwoller DP. *Evaluating Lung Cancer Screening Across Diverse Healthcare Systems: A Process Model from the Lung PROSPR Consortium*. Cancer Prev Res (Phila). 2020 Feb;13(2):129-136. doi: 10.1158/1940-6207.CAPR-19-0378. Epub 2019 Dec 23. PMID: 31871221; PMCID: PMC7010351.

Continuum of Lung Cancer Screening



Screen Eligible

Real-World Clinical Implementation of Lung Cancer Screening-Evaluating Processes to Improve Screening Guidelines-Concordance

Carroll NM, Burnett-Hartman AN, Joyce CA, Kinnard W, Harker EJ, Hall V, Steiner JS, Blum-Barnett E, Ritzwoller DP. *Real-world Clinical Implementation of Lung Cancer Screening-Evaluating Processes to Improve Screening Guidelines-Concordance*. J Gen Intern Med. 2020 Apr;35(4):1143-1152. doi: 10.1007/s11606-019-05539-w. Epub 2020 Jan 23. PMID: 31974902; PMCID: PMC7174472.

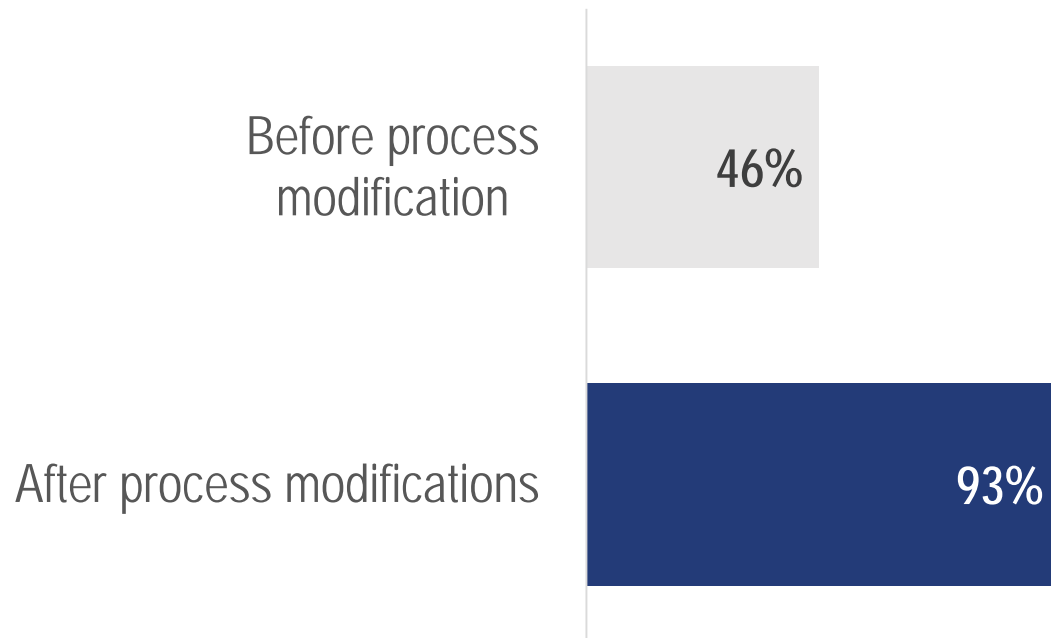
Background and Objectives

- In 2018, few studies outside of the VA had yet to evaluate the community-based implementation of LCS
- Evaluate the impact of LCS implementation process modifications on *compliance with LCS-based eligibility guidelines*.
- Compare patient characteristics and outcomes with those in NLST.



Results

After modifying LCS eligibility confirmation processes¹, patients receiving S-LDCT who met guidelines-based **LCS eligibility** criteria increased.

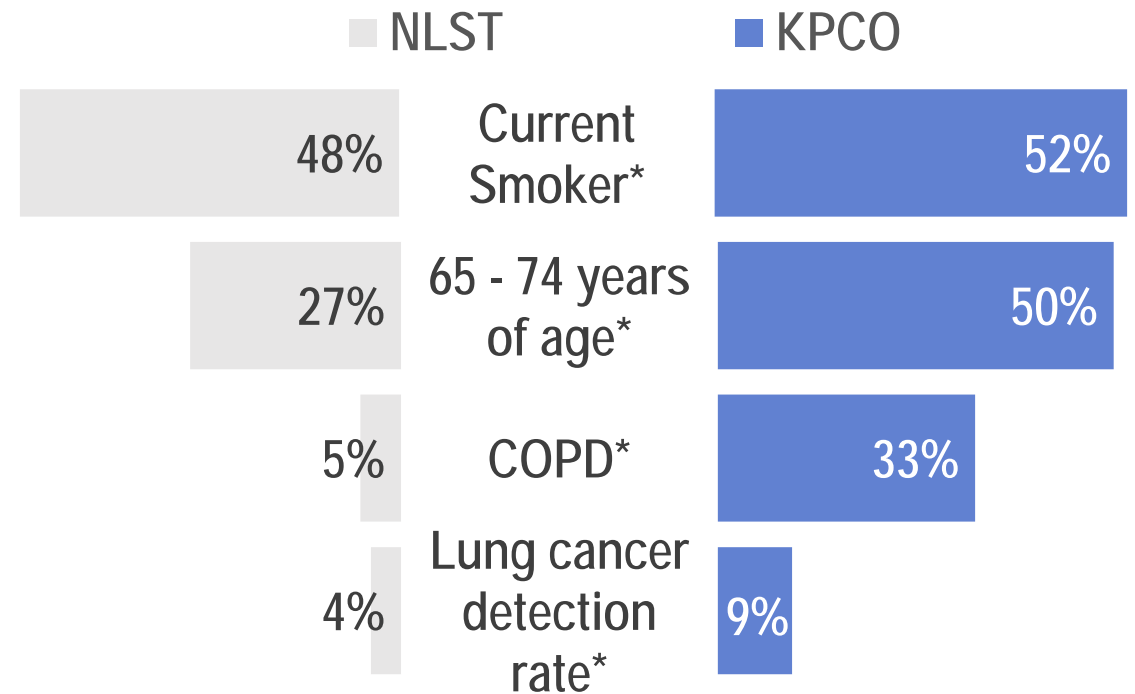


¹ Process Modifications:

- Formal referral process implemented
- Centralized Nurse Navigator monitors



Compared to **NLST** participants, **KPCO patients** undergoing LCS NLST were older, more likely to currently smoke and have pulmonary disease. Among those with a positive baseline S-LDCT, lung cancer detection rate was higher at KPCO.



** p < .0001

Overall Findings - Takeaway

- Adherence to LCS guidelines requires *eligibility confirmation procedures*.
- Among those with a **positive** baseline LDCT for LCS, comorbidity burden and lung cancer detection rates were notably higher than in NLST, suggesting that the study of long-term outcomes in patients undergoing LCS in real-world clinical settings is warranted.



Screen Eligible

Evaluation of Population-Level Changes Associated With the 2021 US Preventive Services Task Force Lung Cancer Screening Recommendations in Community-Based Health Care Systems

Ritzwoller DP, Meza R, Carroll NM, Blum-Barnett E, Burnett-Hartman AN, Greenlee RT, Honda SA, Neslund-Dudas C, Rendle KA, Vachani A. *Evaluation of Population-Level Changes Associated With the 2021 US Preventive Services Task Force Lung Cancer Screening Recommendations in Community-Based Health Care Systems*. JAMA Netw Open. 2021 Oct 1;4(10):e2128176. doi: 10.1001/jamanetworkopen.2021.28176. PMID: 34636916.

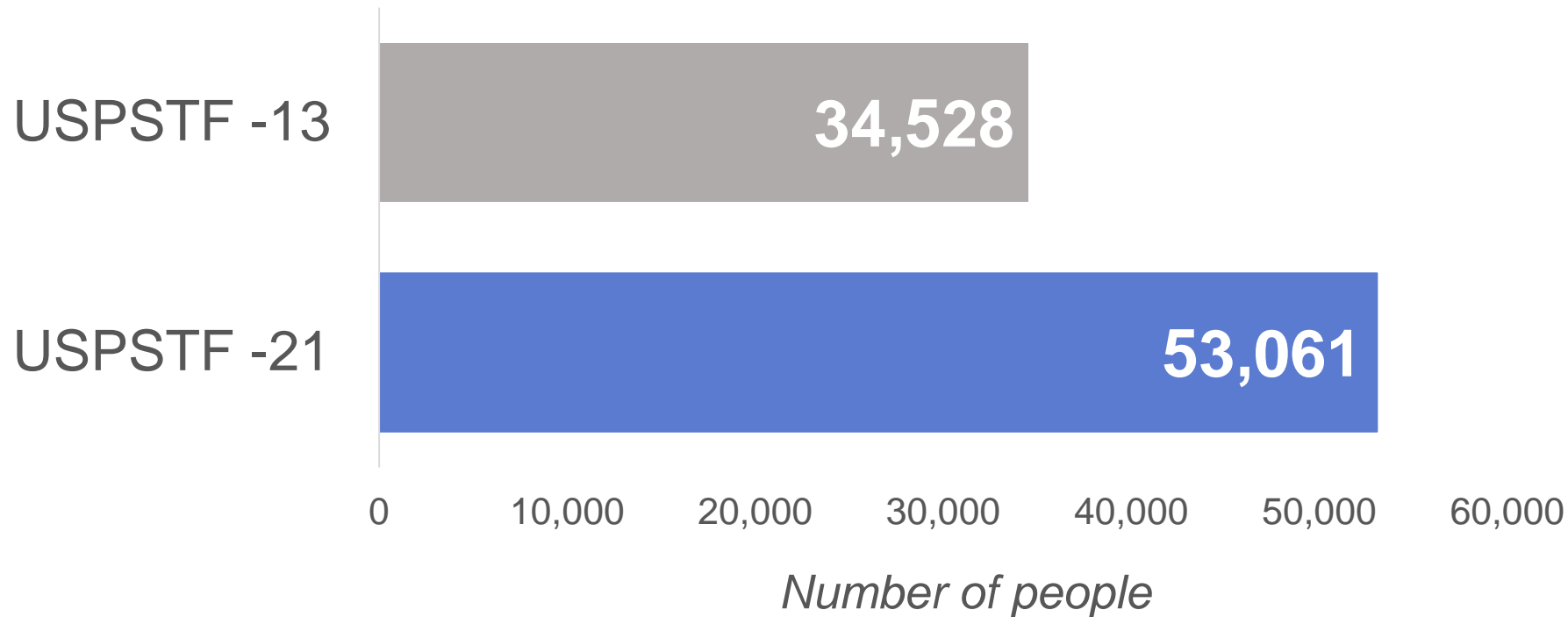
Background and Objective

- **CISNET** models that informed USPSTF 2021 estimated that the expanded eligibility criteria would increase LCS by **87%**, and the relative proportion of women, Non-Hispanic Blacks (NHB), Hispanics, and Asians would increase by 96%, 106%, 112%, and 61%, respectively.
- Two recent papers employing BRFSS survey data found that the USPSTF 2021 guideline may *perpetuate lung cancer disparities*
 - Nrayan et al. (2021) found that racial and ethnic minorities are still less likely to be eligible for LCS
 - Lozier et. al.,(2021) Suggest that given *the association insurance may have on the ability to be screened*, disparities could paradoxically worsen rather than improve

Our objective was to assess whether or not the 2021 USPSTF expansion of lung cancer screening eligibility was associated with a clinically meaningful change in the distribution of the characteristics of individuals who are newly eligible for screening within and across PROSPR-lung



USPSTF-21 Guideline Change will Expand the LOTUS Screening Eligible Population* by 54%**

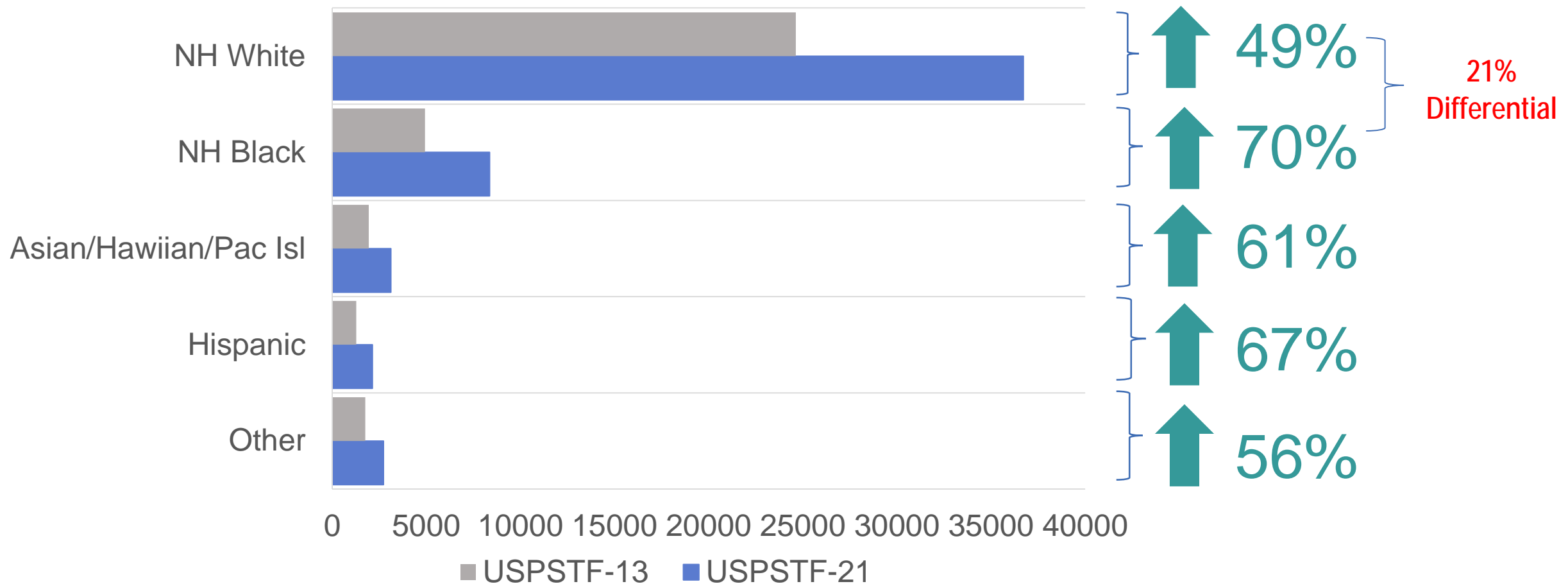


* Limited to LOTUS population with complete smoking history data, including pack-years and smoking quit date. **Excludes ~ 300K current and previous tobacco users within the LOTUS cohort with missing complete smoking data**

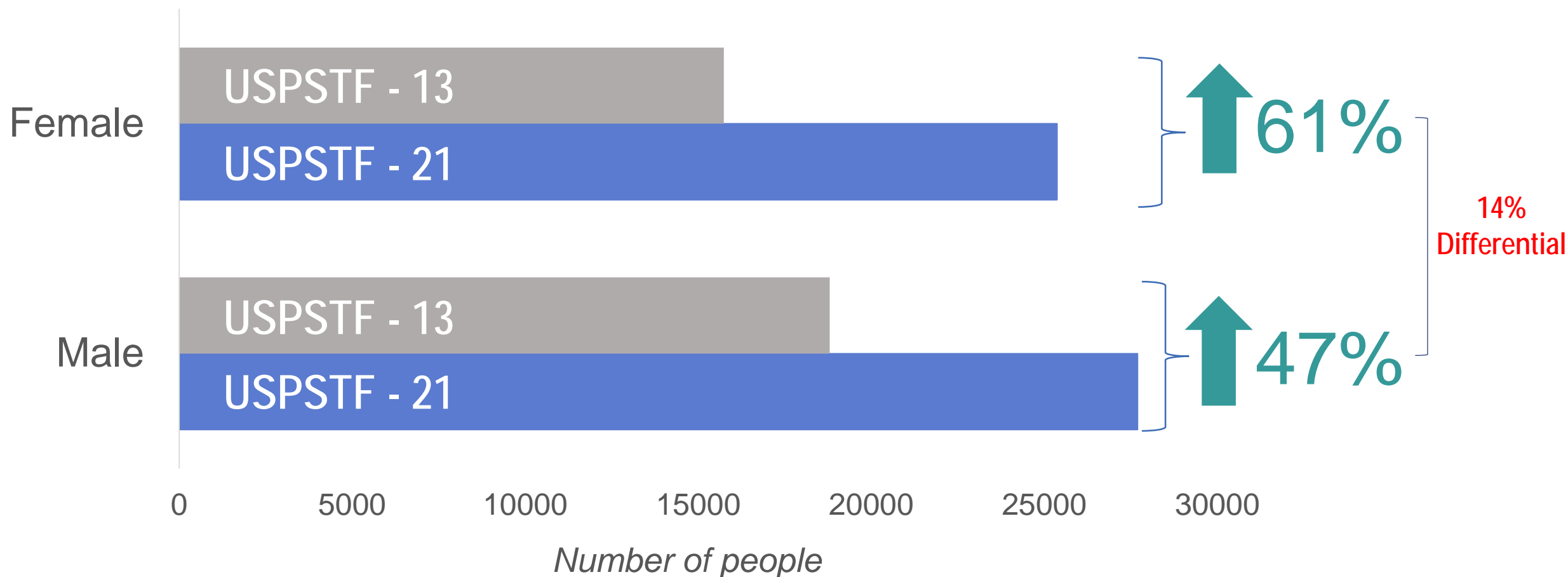
** CISNET models estimated an expansion of 87%



USPSTF-21 Guideline Change in Overall and Newly Eligible by Race/Ethnicity

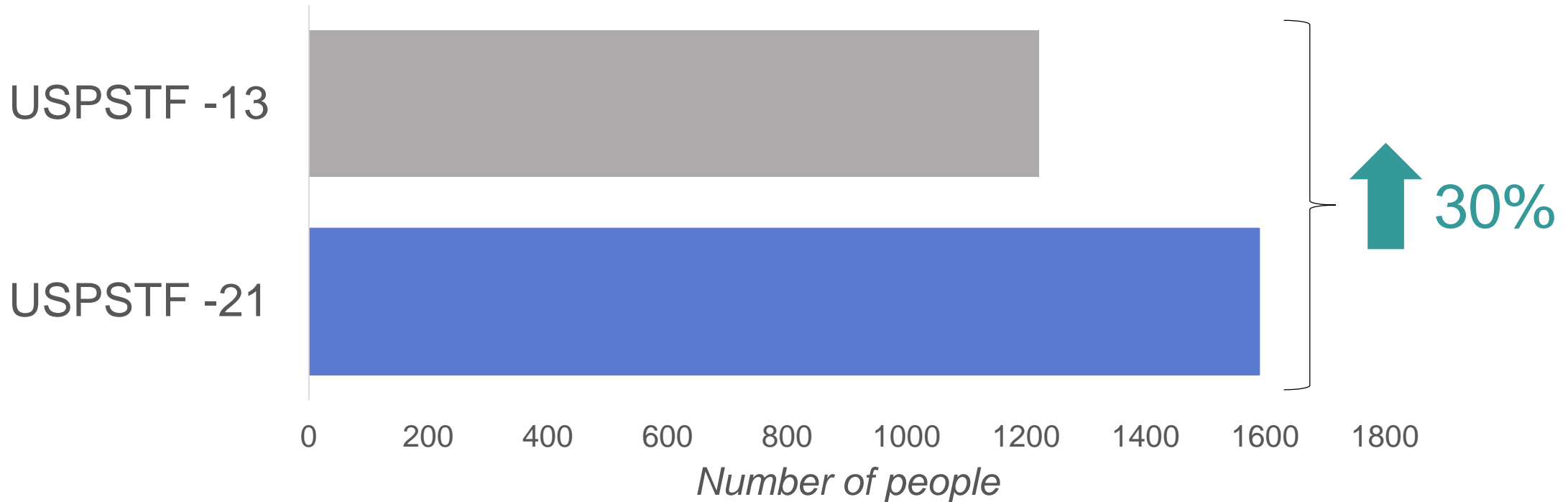


USPSTF-21 Guideline Change in Overall Newly Eligible by SEX



LOTUS Individuals with Incident Lung Cancers Meeting USPSTF-13 vs USPSTF-21 Guidelines*

*The largest relative increase is associated with NH Blacks who had a 20-percentage point differential over NH Whites

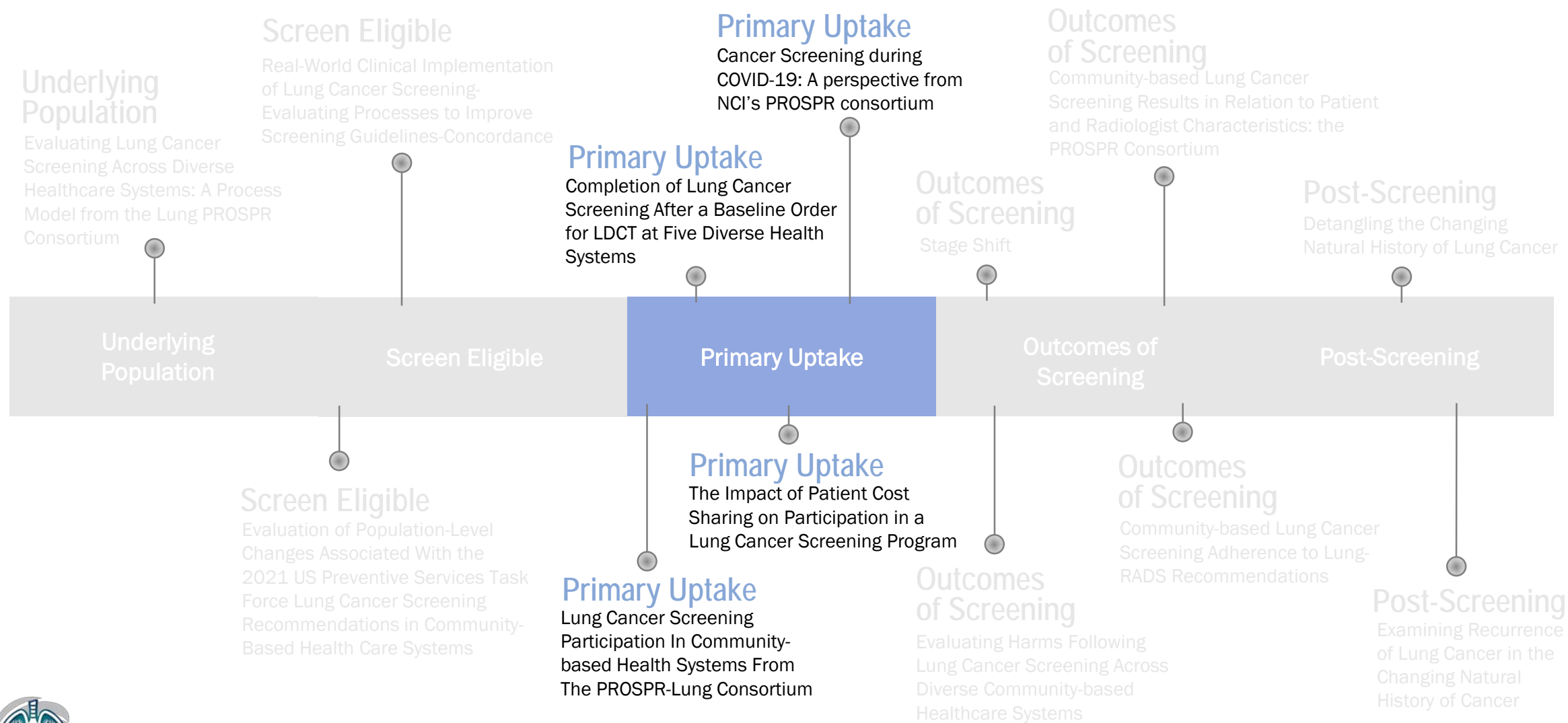


Overall Findings - Takeaway

- Health care systems should plan to increase LCS capacity 50% to 60%
- Updated criteria may help reduce barriers to screening access for **insured** individuals, **who are engaged with health care systems**, and who are at highest risk for lung cancer
- ***Capture of smoking status needs improvement!



Continuum of Lung Cancer Screening



Primary Uptake

Completion of Lung Cancer Screening After a Baseline Order for LDCT at Five Diverse Health Systems

Neslund-Dudas, C, Tang A, Alleman E, Lafata JE, Honda SA, Oshiro C, Rendle KA, Vachani A, Olaiya O, Greenlee RT, Simoff M, Ritzwoller DP. (2021, June 4). *Completion of Lung Cancer Screening After a Baseline Order for LDCT at Five Diverse Health Systems* [Poster presentation]. ASCO Annual Meeting. <https://meetings.asco.org/abstracts-presentations/197367>

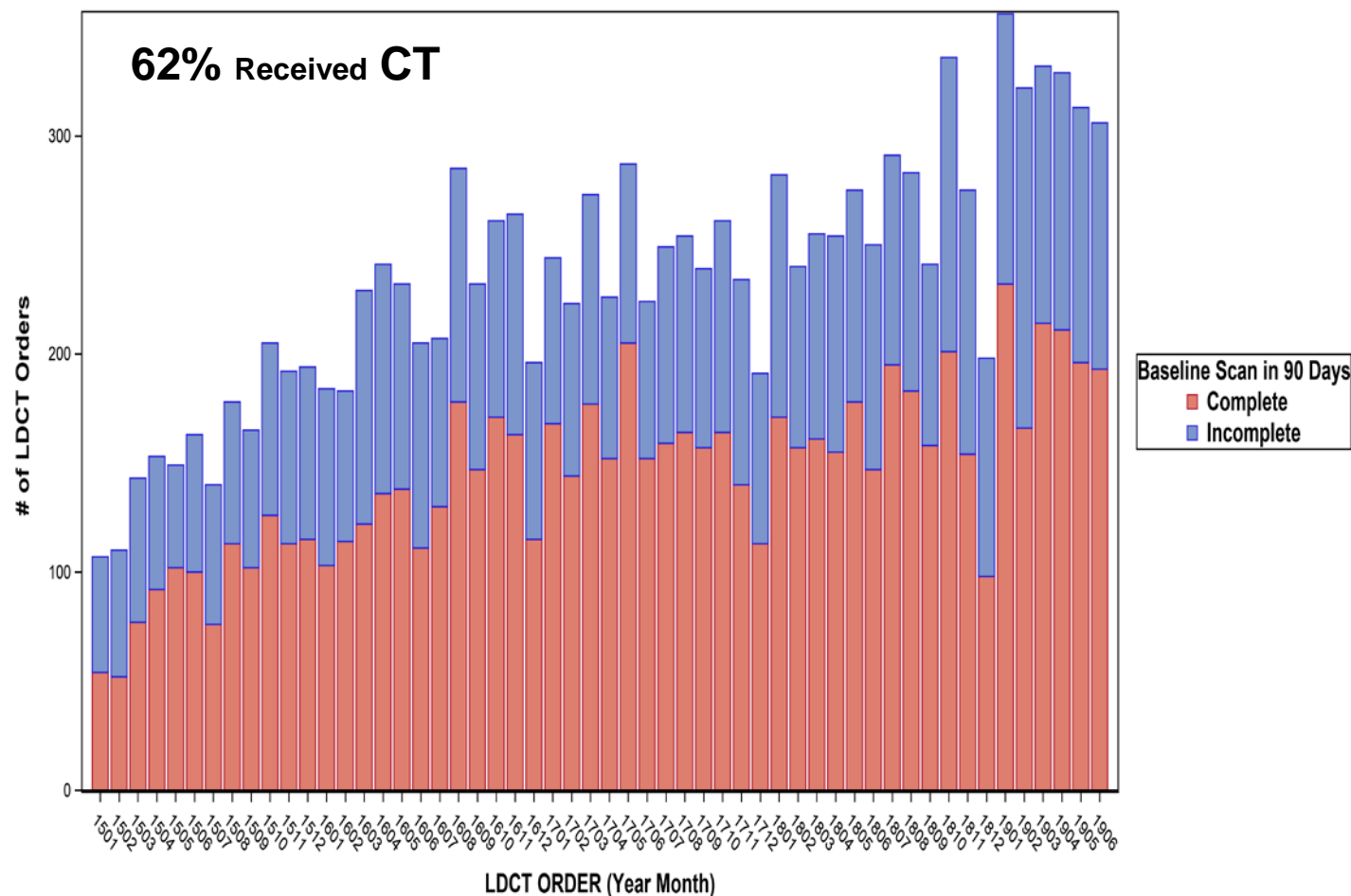
Background and Objectives

- Little is known regarding the primary uptake of LCS after an **order or a referral** for LCS
- Determine uptake of baseline LCS among those who received a provider-initiated order (or referral) for screening
- Determine if individual level factors or census tract proxies of SES/SDoH are associated with completing a screen after order for CT



Uptake of Baseline Lung Cancer Screening LDCT

LDCT within 90 days of Order
1/2015 – 6/2019
N=12,661



Factors Associated with Completion of an LDCT after a Screening Order

Variable	OR**	95%CI	P-value
Age	1.01	1.00-1.02	0.19
Sex			
Female	ref		
Male	1.11	1.03-1.19	<0.0001
Race/Ethnicity			
White	ref		
Black	1.00	0.84-1.22	0.95
Hispanic	1.05	1.00-1.12	0.06
Oth/Unk	0.94	0.82-1.07	0.35
Smoking			
Current	ref		
Former	1.19	1.10-1.30	<0.0001
Centralized LCS Program			
No	Ref		
Yes	1.32	1.21-1.43	<0.0001
Comorbidity			
0	ref		
≥1	1.13	1.07-1.19	<0.001

**Adjusted for the other variables in the table as well as year of order and health system

Overall Findings - Takeaway

- Overall, 62% of those receiving an order for LCS received a screening LDCT within 90-days
- Male sex, older age, being a former smoker and greater comorbidity were associated with increased likelihood of completing a screen
- We also observed some associations between gender and race differences in uptake
 - Stratified analyses found lower uptake Black men who have historically had the worst outcomes from lung cancer
 - More analyses are underway



Primary Uptake

Lung Cancer Screening Participation in Community-Based Health Systems From the PROSPR-Lung Consortium

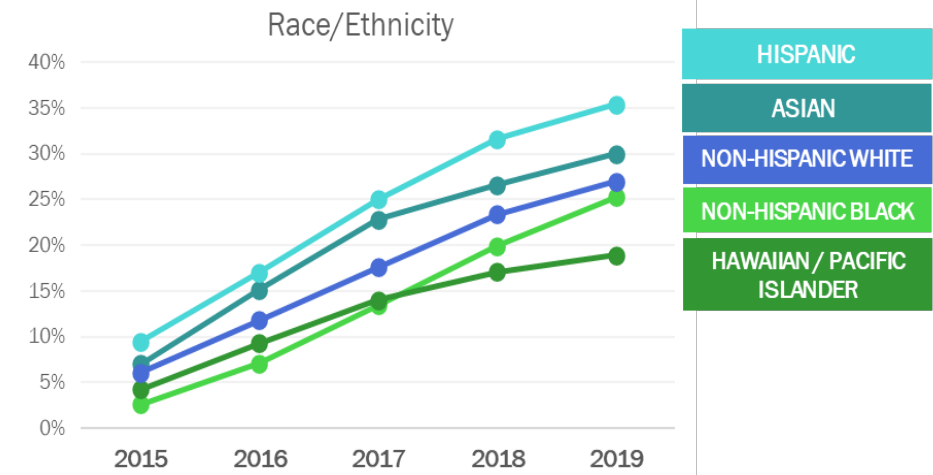
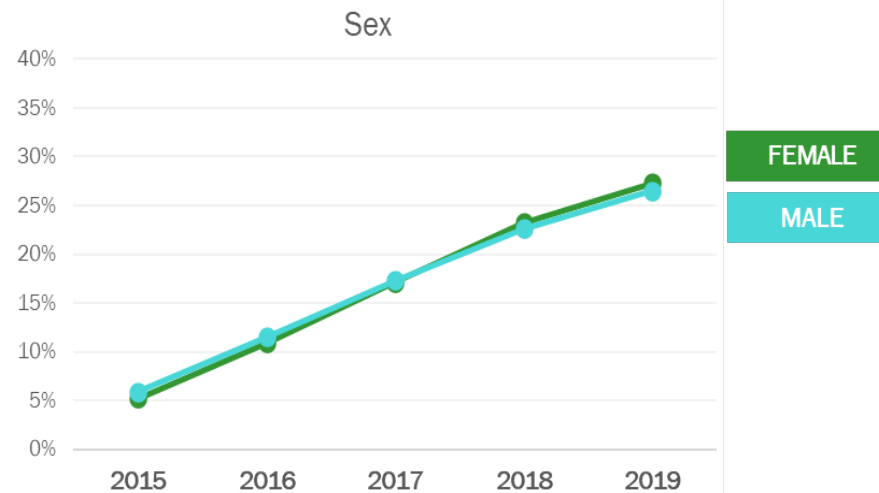
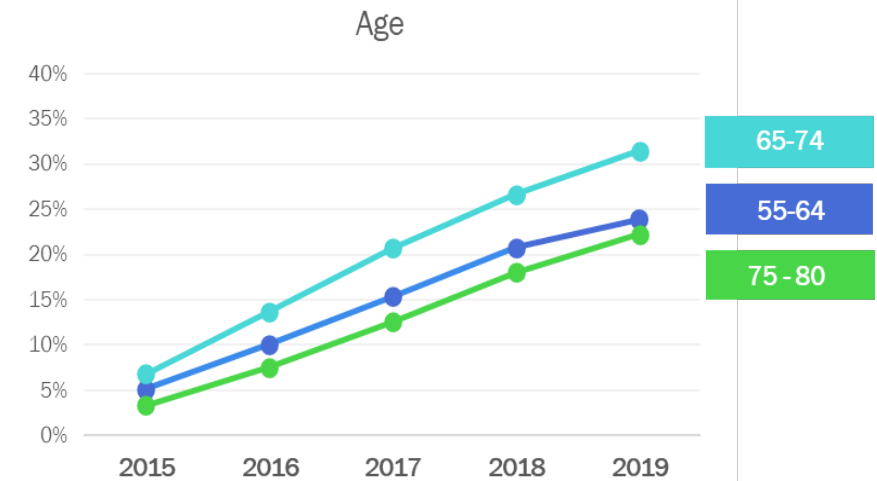
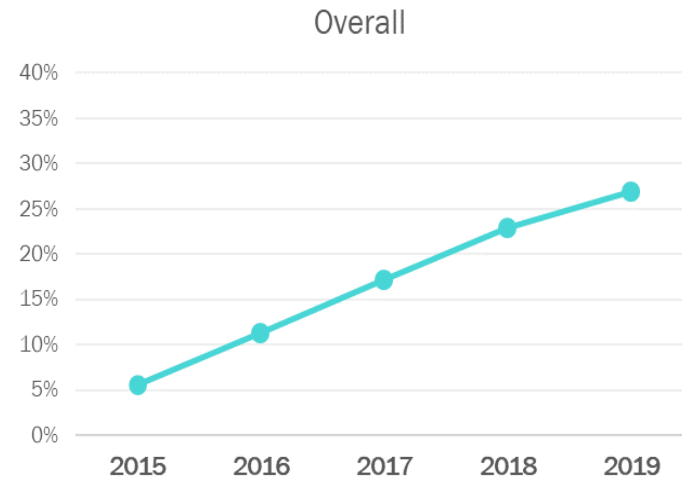
Burnett-Hartman AN, Carroll NM, Croswell J, Greenlee RT, Honda SA, Neslund-Dudas C, Rendle KA, Vachani A, Ritzwoller DP. (2021, October 17-20). *Lung Cancer Screening Participation in Community-Based Health Systems From the PROSPR-Lung Consortium* [Poster presentation]. CHEST Annual Meeting.

Background and Objectives

- As noted previously, current studies in the VA, regional community cohorts, and BRFSS survey data show relatively low uptake in LCS
- Out of those who meet USPSTF-13 eligibility criteria, estimate the proportion of the study population who have ever completed at least 1 LDCT for LCS over time, overall, and by age, sex, and race/ethnicity.
- Estimate the factors associated with participating in LCS.

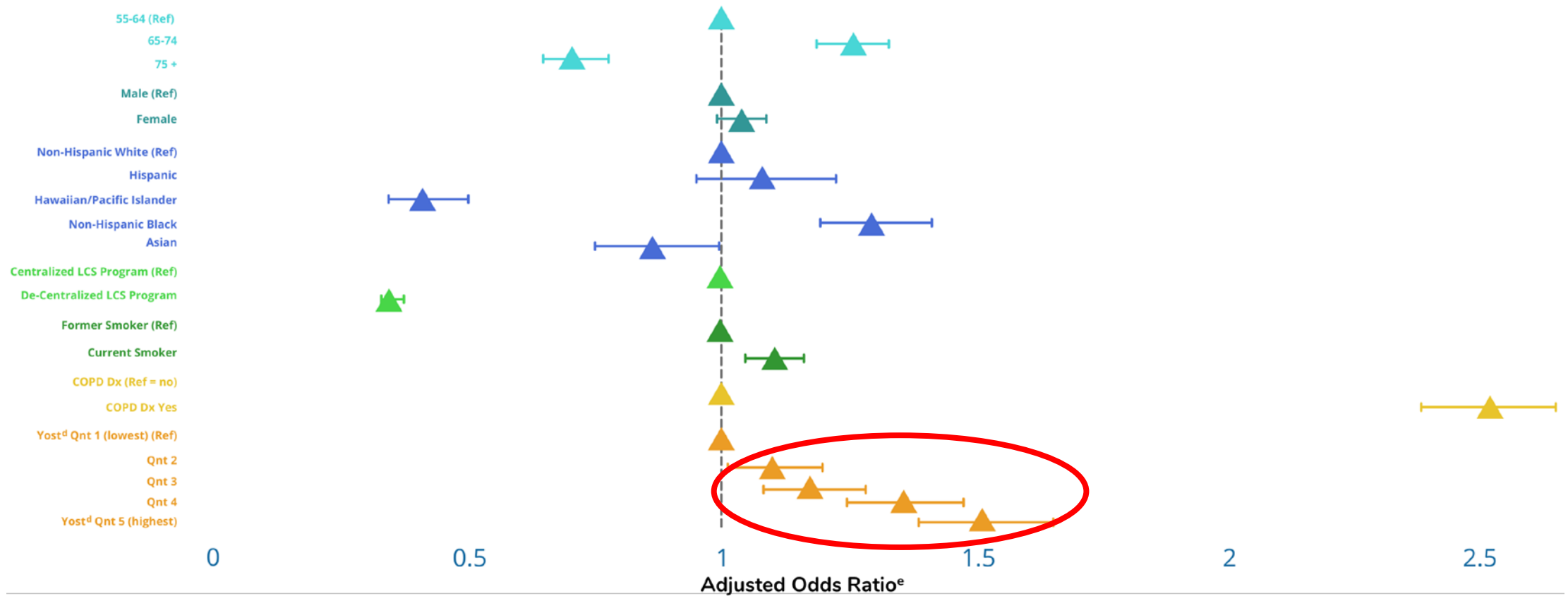


Participation in Screening 2015-2019, Overall & by Age, Sex, & Race/Ethnicity



% having ever received at least 1 LDCT for LCS among those who met USPSTF-13 LCS eligibility criteria as of 12/31 of each year

Factors Associated with Being Up-to-Date with Lung Cancer Screening as of 9/30/2019



c: Received a chest CT for any indication in the prior 12 months, among those who met USPSTF-13 LCS eligibility criteria as of September 30, 2019

d: The Yost Index is a composite index of census tract-level socioeconomic factors, such as age and income

e: Mutually adjusted for all factors in Figure 6



Overall Findings - Takeaway

- LCS rates in community-based healthcare settings remain well below screening rates for other types of cancers and there is variation in LCS participation by patient and health system factors.
- To optimize the impact of LCS for reducing disparities in lung cancer mortality healthcare systems will need to address outreach and follow-up – especially for those with low resources who are at high risk .



Primary Uptake

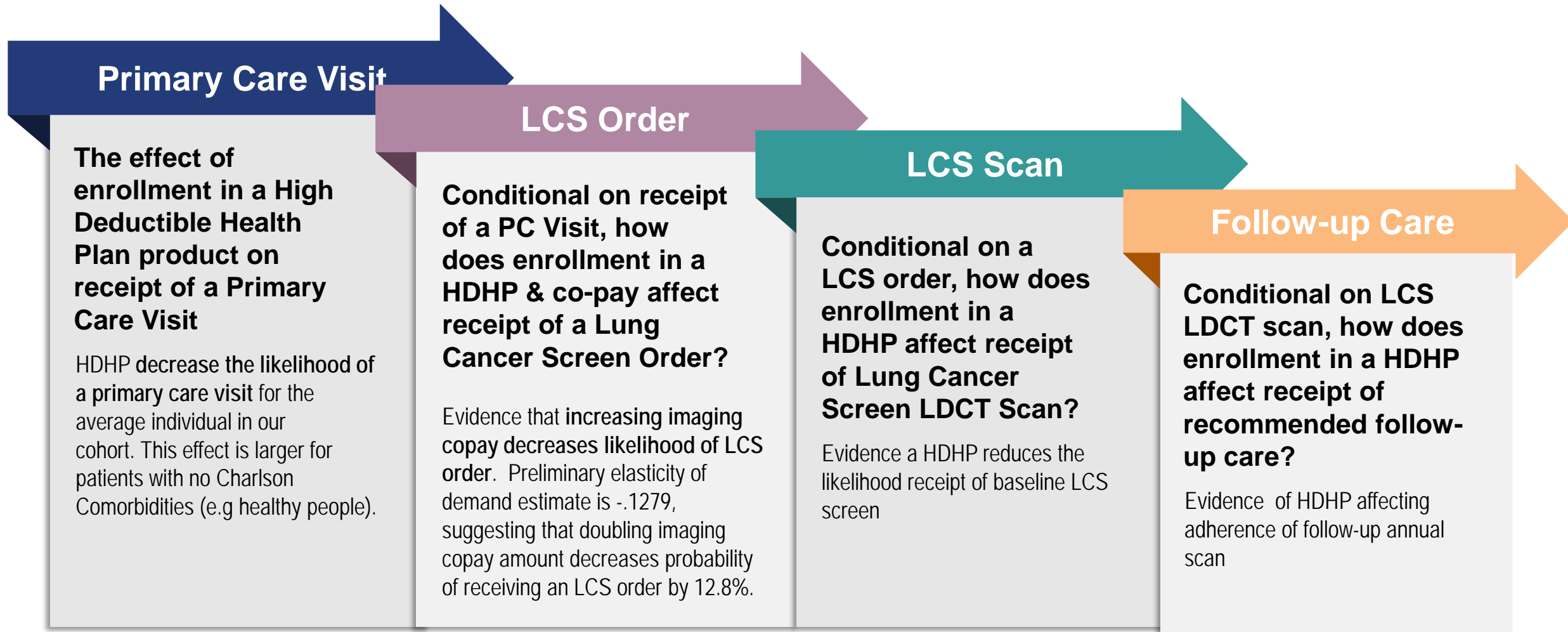
The Impact Of Patient Cost Sharing On Participation In A Lung Cancer Screening Program

Working Paper: Wain K, Carroll NM, Ritzwoller Dp

Background and Objective

- Literature is mixed regarding the impact of high deductible health plans (HDHPs) on cancer screening.
- Goal to assess the impact of enrollment in and HDHP health plan on LCS uptake, for individuals <65 yrs

Patient Cost-sharing and LCS



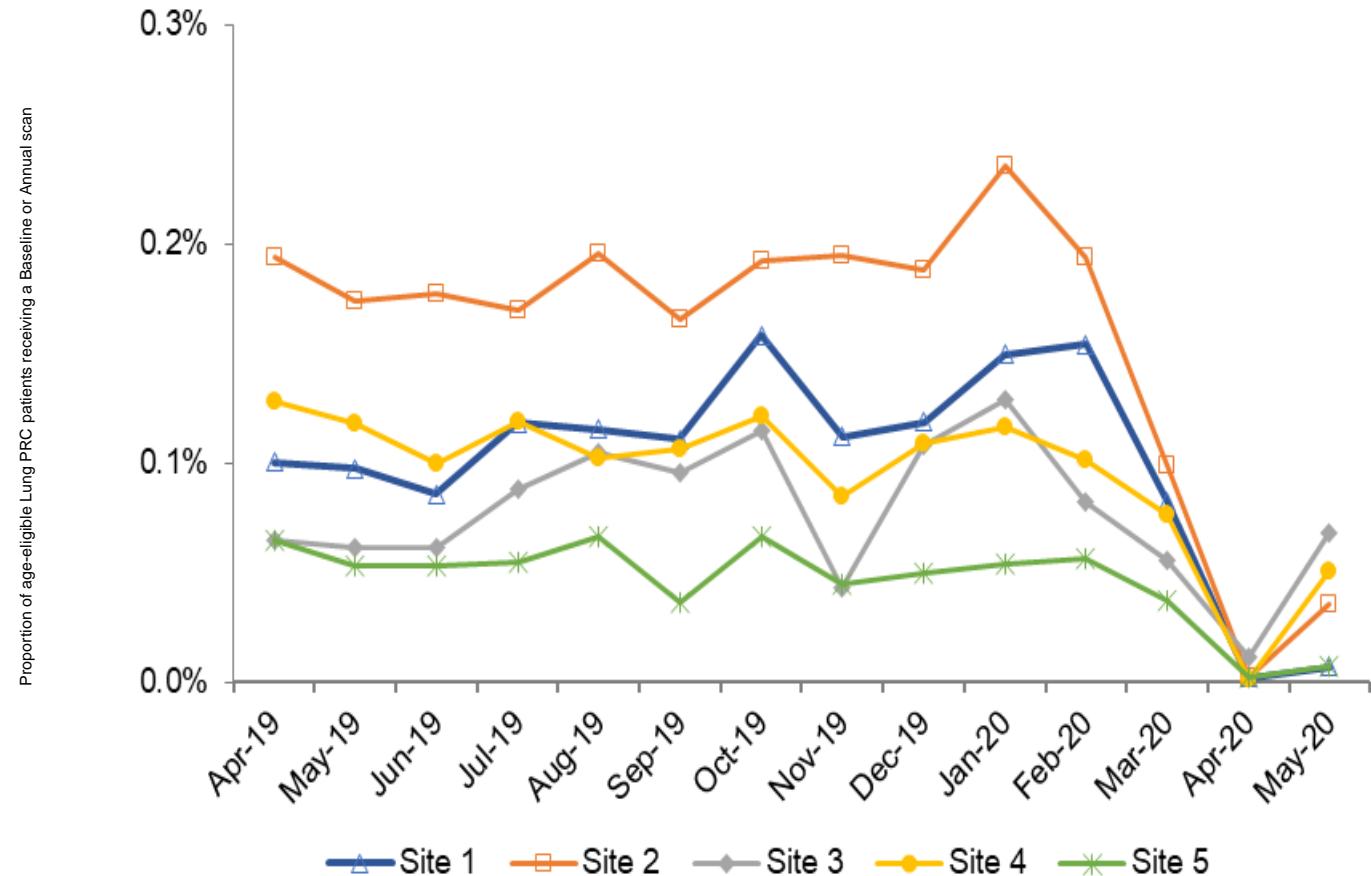
Primary Uptake

Cancer Screening during COVID-19: A perspective from NCI's PROSPR consortium

National Cancer Institute's PROSPR Consortium, Corley DA, Sedki M, Ritzwoller DP, Greenlee RT, Neslund-Dudas C, Rendle KA, Honda SA, Schottinger JE, Udaltsova N, Vachani A, Kobrin S, Li CI, Haas JS. *Cancer Screening During the Coronavirus Disease-2019 Pandemic: A Perspective From the National Cancer Institute's PROSPR Consortium. Gastroenterology.* 2021 Mar;160(4):999-1002. doi: 10.1053/j.gastro.2020.10.030. Epub 2020 Oct 21. PMID: 33096099; PMCID: PMC7575503.

COVID-19
Related LCS
Disruption:
Dramatic
decrease in LCS
across all
PROSPR-Lung
health systems

Lung Cancer Screening Rates- PROSPR Lung *

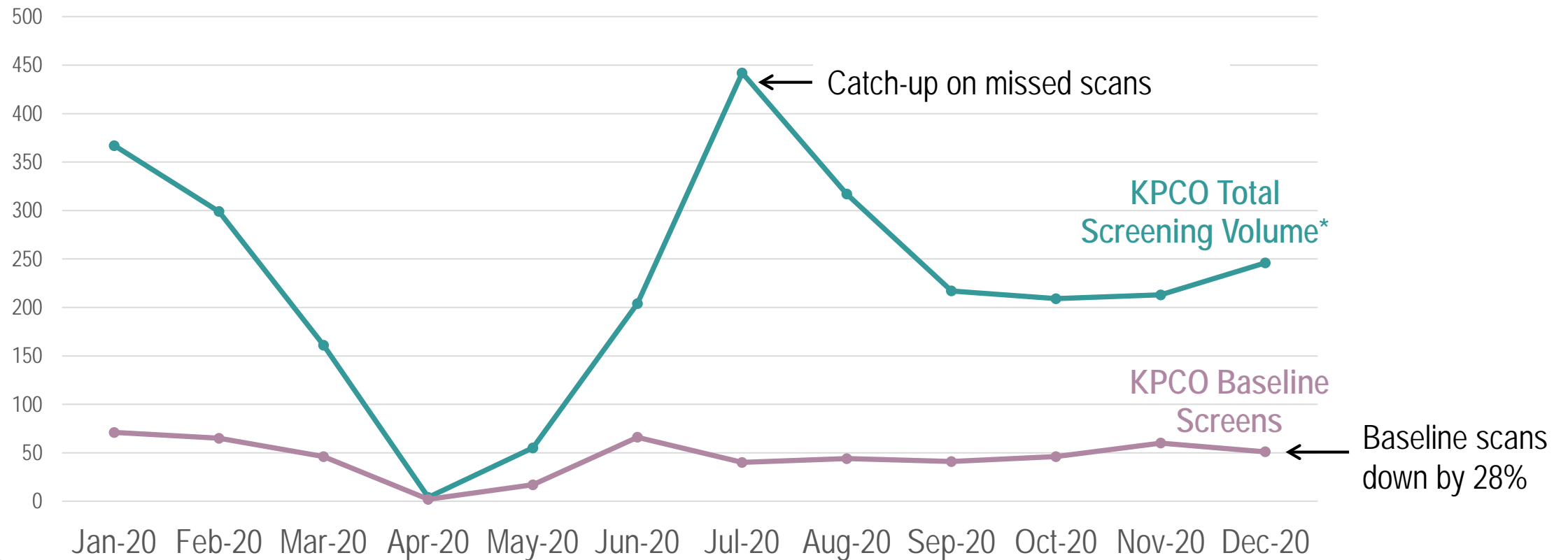


*Corley DA, Sedki M, Ritzwoller DP, Greenlee RT, Neslund-Dudas C, Rendle KA, Honda SA, Schottinger JE, Udaltsova N, Vachani A, Kobrin S, Li CI, Haas JS. Cancer Screening during COVID-19: A Perspective from NCI's PROSPR consortium. *Gastroenterology*. 2020 Oct 21:S0016-5085(20)35317-8. doi: 10.1053/j.gastro.2020.10.030..

Van Haren RM, Delman AM, Turner KM, Waits B, Hemingway M, Shah SA, Starnes SL. Impact of the COVID-19 Pandemic on Lung Cancer Screening Program and Subsequent Lung Cancer. *J Am Coll Surg*. 2021 Apr;232(4):600-605. doi: 10.1016/j.jamcollsurg.2020.12.002

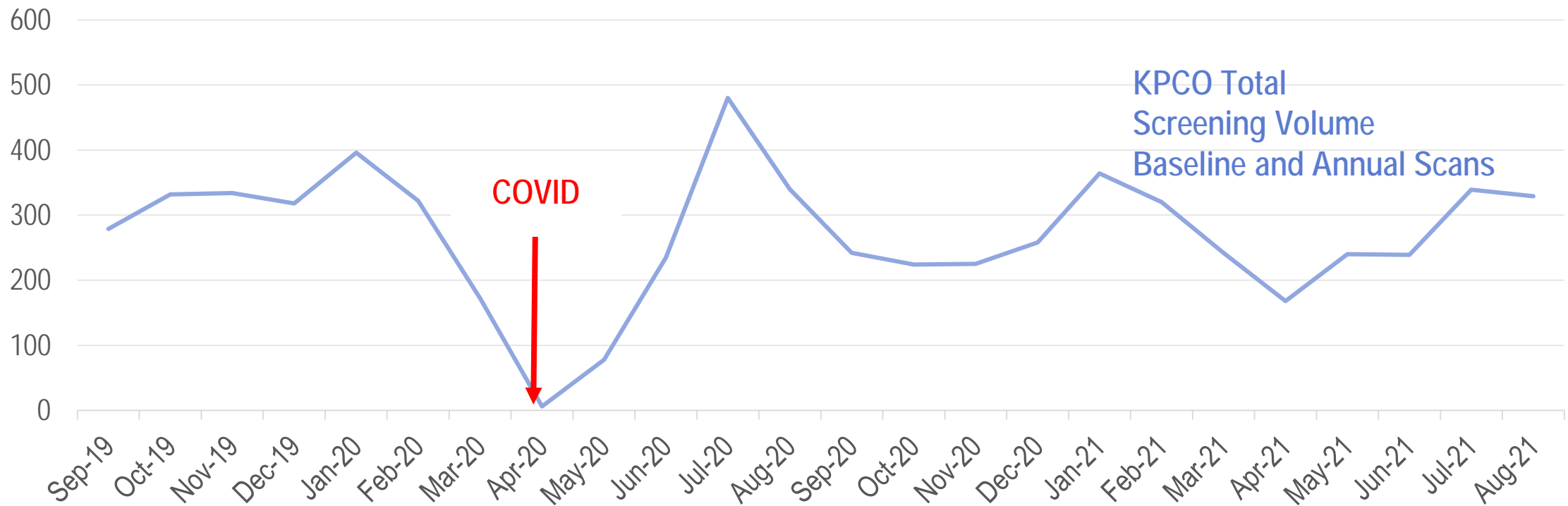
LCS Remains Lower than Pre-COVID Levels

2020 data from KPCO shows a re-bound but initiation of first-time (baseline) LCS is declined with the shift to Telehealth and “Virtual First” modes of care



LCS Remains Lower than Pre-COVID Levels

2020-21 data from KPCO shows re-bound in overall screening but initiation of first-time (baseline) LCS is not returning to pre-COVID-19 levels

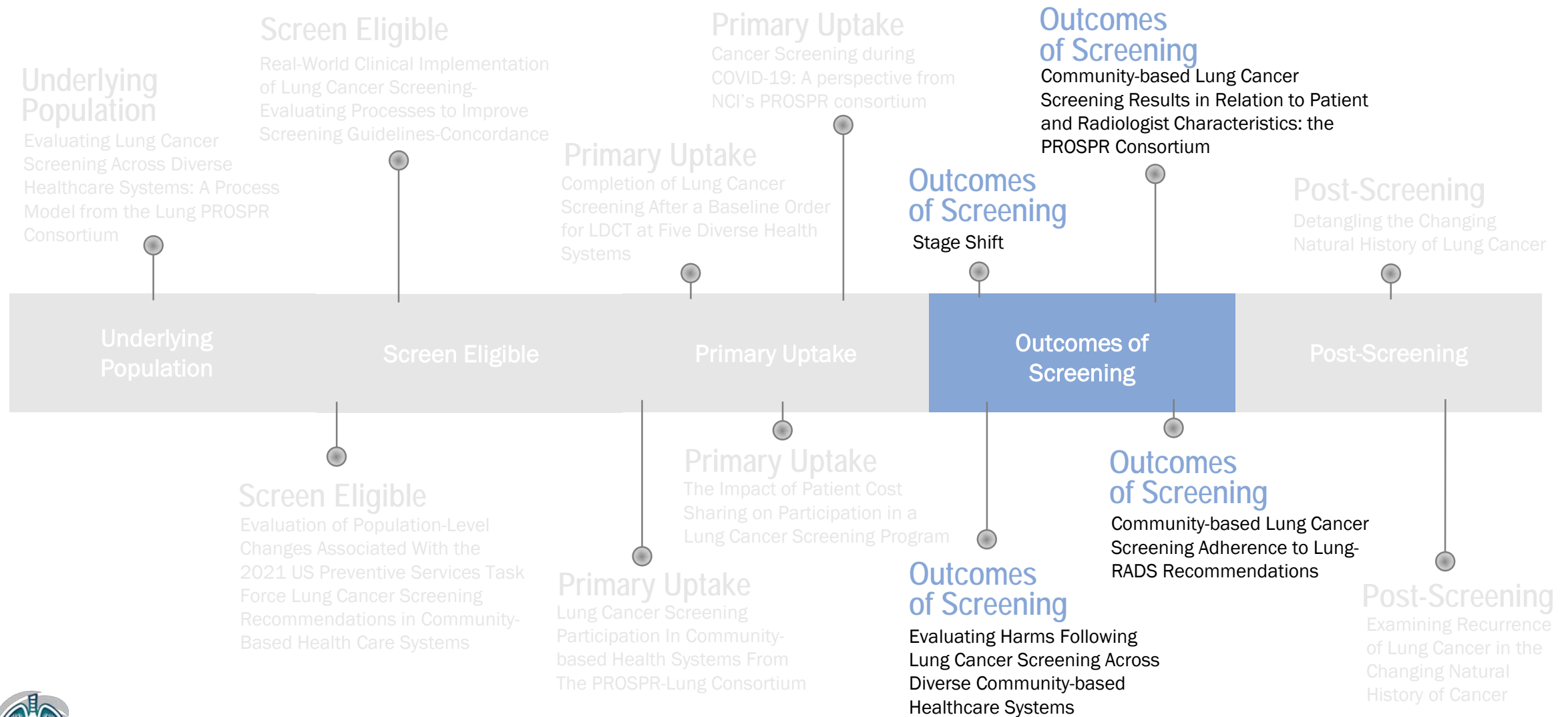


Overall Findings - Takeaway

- Screening reductions were uniform across PROSPR-Lung sites and across other organ sites
- Remote cancer screening methods (e.g mailed FIT tests) currently do not have an analog in LCS.
- COVID19 pandemic resulted in care delivery interruptions, a shift to Telehealth, losses of employer sponsored health insurance, etc,
 - Exploring how COVID19, along with these changes, differentially impacted LCS for those at highest risk for lung cancer.



Continuum of Lung Cancer Screening



Outcomes of Screening

Community-based Lung Cancer Screening Results in Relation to Patient and Radiologist Characteristics: the PROSPR Consortium

Burnett-Hartman AN, Carroll NM, Honda SA, Joyce C, Mitra N, Neslund-Dudas C, Olaiya O, Rendle KA, Schnall MD, Vachani A, Ritzwoller DP. *Community-based Lung Cancer Screening Results in Relation to Patient and Radiologist Characteristics: the PROSPR Consortium*. Ann Am Thorac Soc. 2021 Sep 20. doi: 10.1513/AnnalsATS.202011-1413OC..

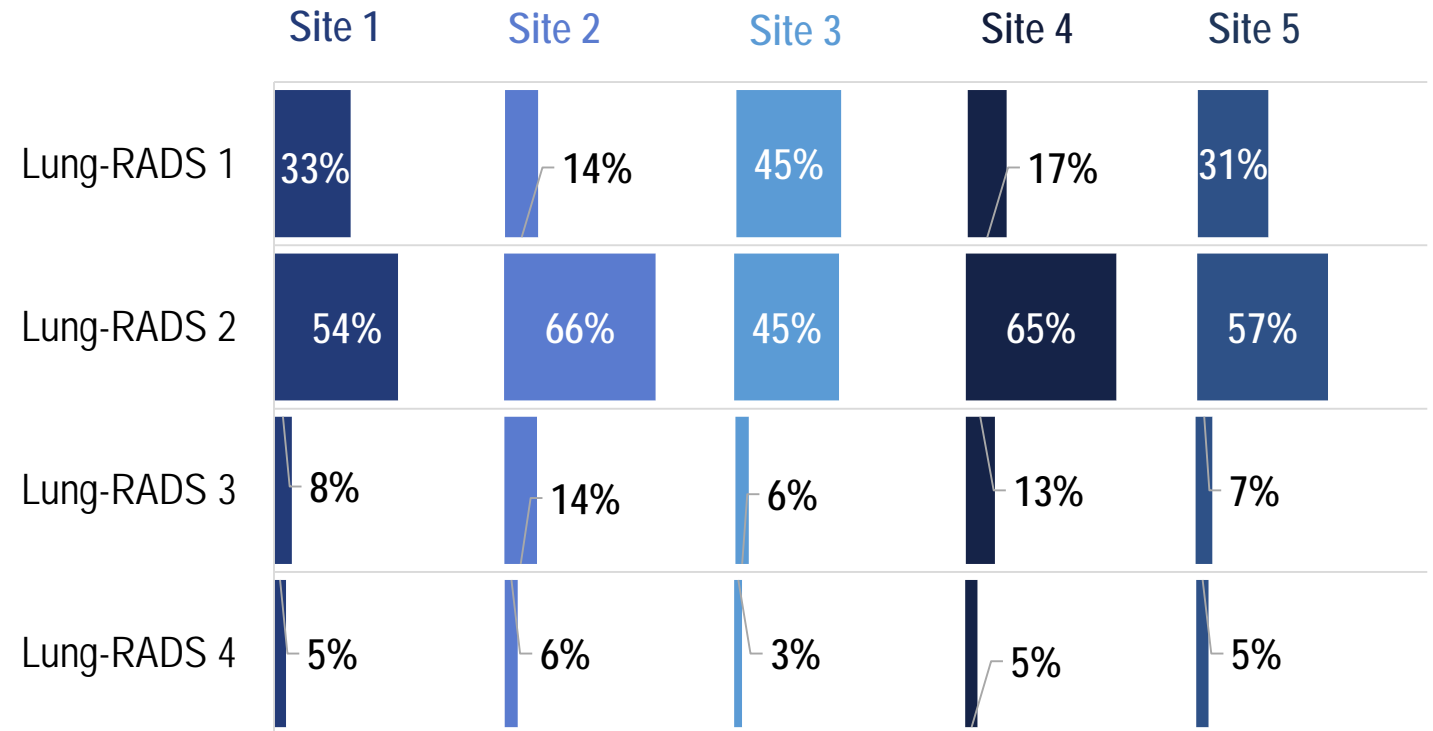
Background and Objectives

- Lung-RADS classification was developed to standardize reporting and management of lung cancer screening using low-dose computed tomography (LDCT).
- Variation in Lung-RADS distribution between healthcare systems has been reported, it is unclear if this is explained by patient characteristics, radiologist experience with lung cancer screening, or other factors.
- Our objective was to determine if patient or radiologist factors are associated with Lung-RADS score.



Lung-RADS Assignment Differs By Health System

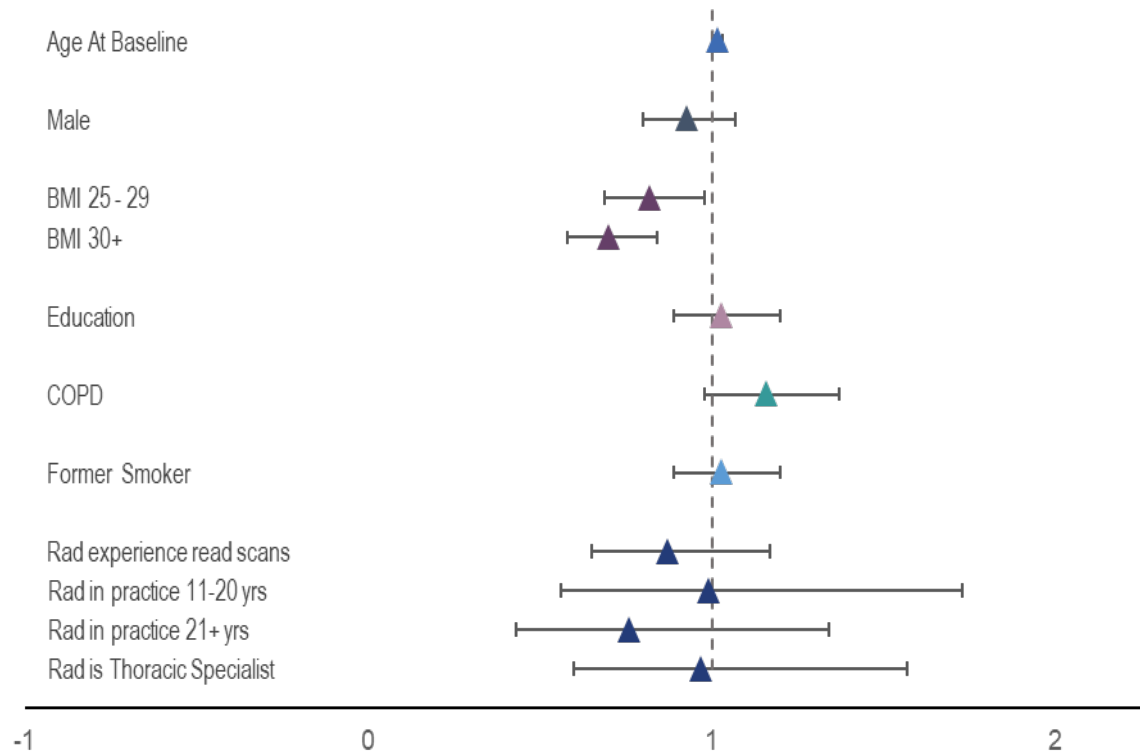
*Distribution of Baseline Screen Lung-RADS**



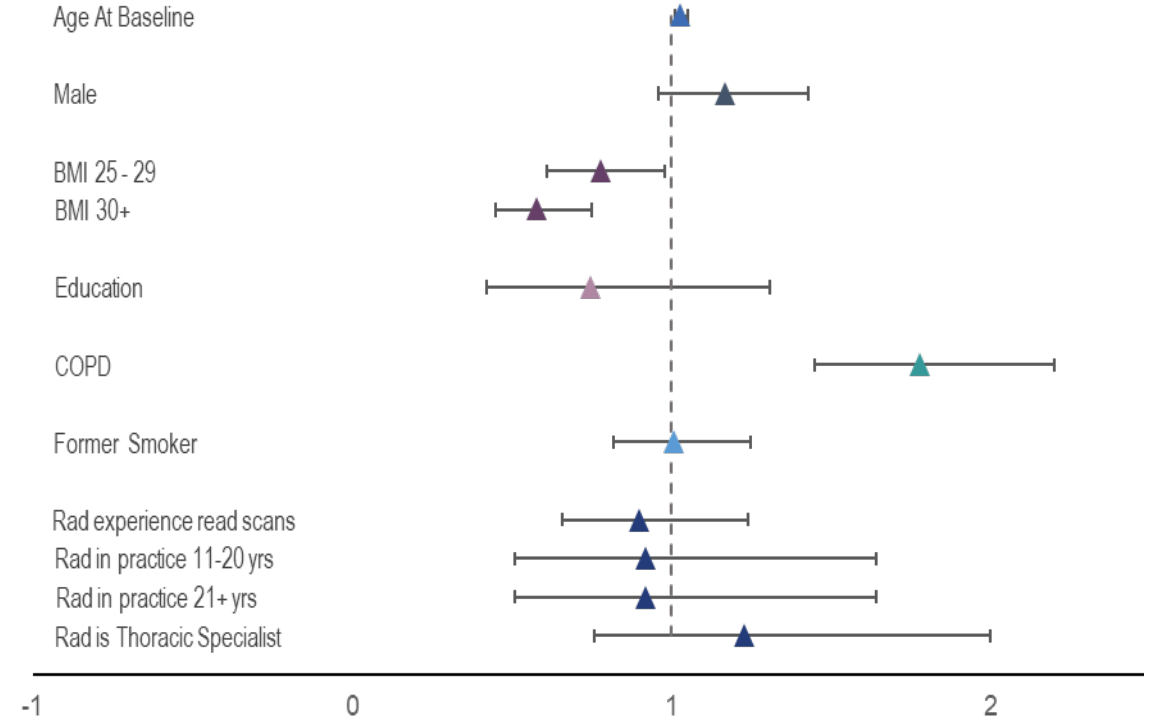
***Baseline Screen Definition:** First LCS screening code (G0297, S8032) detected between 1/1/2014 and 9/30/19

Factors Associated with Lung-RADS

Lung-RADS 3



Lung-RADS 4



Overall Findings - Takeaway

- Age and obesity were directly associated with a positive screen (e.g *L-RAD 3 or 4*); obesity was inversely related to a positive screen.
- There was no association between sex, race, ethnicity, education, or smoking status and Lung-RADS assignment. Radiologist volume of interpreting screening LDCTs, years in practice, and thoracic specialty were also not associated with Lung-RADS assignment
- Healthcare systems that are comprised of patients with an older age distribution or higher levels of COPD will have a greater proportion of screening LDCTs with Lung-RADS 3 or 4 findings and should plan for additional resources to support appropriate and timely management of noted positive findings.



Outcomes of Screening

Community-based Lung Cancer Screening Adherence to Lung-RADS Recommendations

Kim RY, Rendle KA, Neslund-Dudas C, Greenlee RT, Burnett-Hartman AN, Honda SA, Simoff MJ, Croswell JM, Ritzwoller DP, Vachani A. (2021, June 4). *Community-based Lung Cancer Screening Adherence to Lung-RADS Recommendations* [Poster presentation]. ASCO Annual Meeting. <https://meetings.asco.org/abstracts-presentations/197367>

Background and Objectives

- Recent studies found that adherence to LCS follow-up recommendations after a baseline screen were generally poor and varied by program characteristics¹⁻³.
- Determine adherence to Lung-RADS recommendations among the PROSPR-Lung community-based patients undergoing LCS across multiple healthcare systems
- Evaluate patient characteristics associated with adherence

¹Tanner NT, Brasher PB, Wojciechowski B, Ward R, Slatore C, Gebregziabher M, Silvestri GA. Screening Adherence in the Veterans Administration Lung Cancer Screening Demonstration Project. *Chest*. 2020 Oct;158(4):1742-1752. doi: 10.1016/j.chest.2020.04.063. Epub 2020 May 19. PMID: 32439505

²Sakoda LC, Rivera MP, Zhang J, Perera P, Laurent CA, Durham D, Huamani Velasquez R, Lane L, Schwartz A, Quesenberry CP Jr, Minowada G, Henderson LM. Patterns and Factors Associated With Adherence to Lung Cancer Screening in Diverse Practice Settings. *JAMA Netw Open*. 2021 Apr 1;4(4):e218559. doi: 10.1001/jamanetworkopen.2021.8559. PMID: 33929519; PMCID: PMC8087957.

³Erkmen CP, Dako F, Moore R, Dass C, Weiner MG, Kaiser LR, Ma GX. Adherence to annual lung cancer screening with low-dose CT scan in a diverse population. *Cancer Causes Control*. 2021 Mar;32(3):291-298. doi: 10.1007/s10552-020-01383-0. Epub 2021 Jan 4. PMID: 33394208; PMCID: PMC7878339.



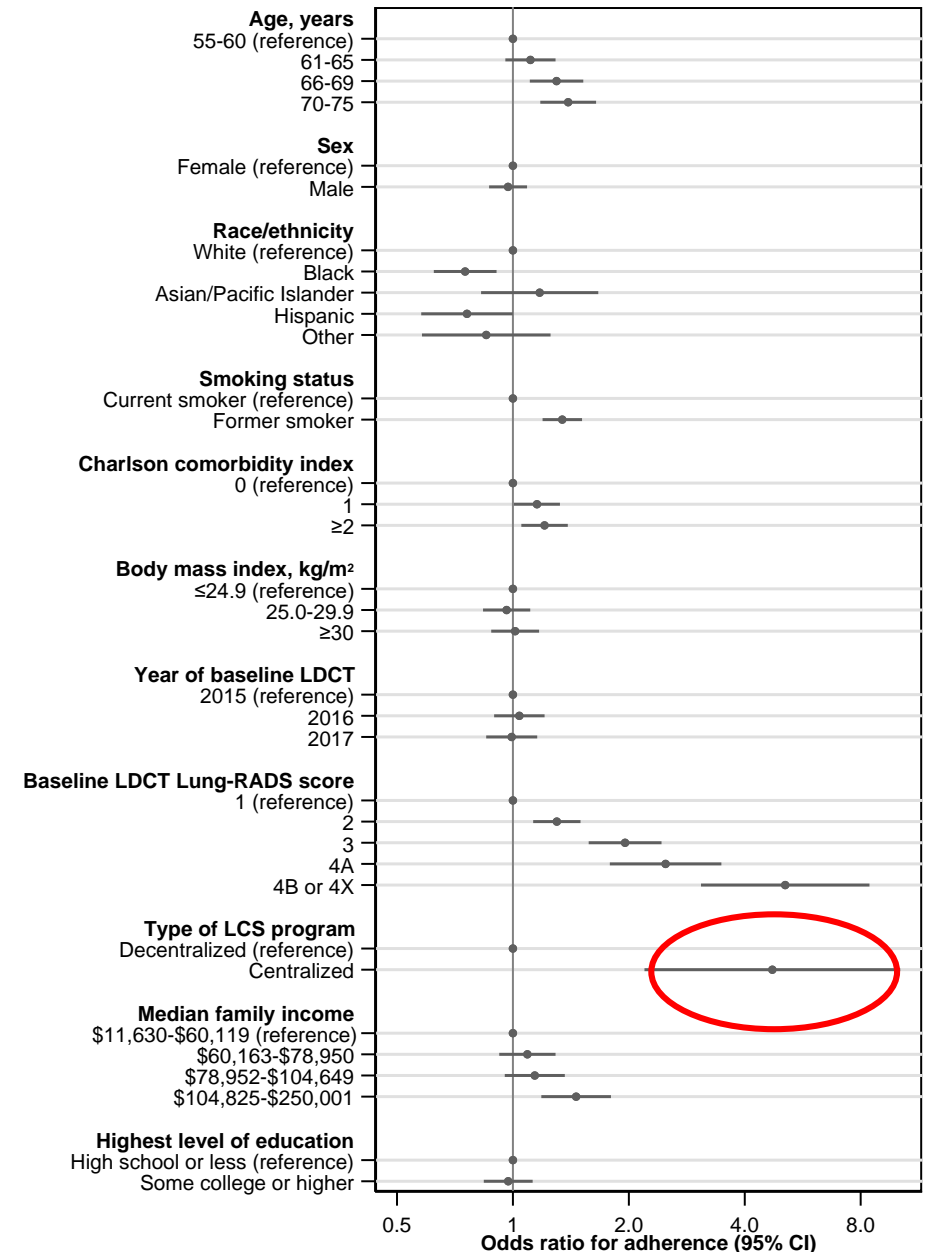
Results

- Associated with **increased adherence**:

- Older age
- Former smoking status
- Higher Charlson comorbidity index
- Higher baseline Lung-RADS scores
- *Centralized lung cancer screening programs*
- Higher median family income

- Associated with **decreased adherence**:

- Black patient race
- Hispanic ethnicity



Overall Findings - Takeaway

- Overall adherence to Lung-RADS recommendations was 57% among adults receiving LCS with LDCT at community-based healthcare systems
- Adherence was significantly higher at centralized (76%) compared to decentralized (39%) screening programs
 - At *decentralized programs*, Black race and negative baseline screens (Lung-RADS 1-2) were associated with decreased adherence while positive screens (Lung-RADS 3-4) were associated with increased adherence
 - At **centralized programs**, adherence was similar across baseline screen result and race/ethnicity
- Older age, former smoking status, and higher median family income were also associated with increased adherence
- Our results highlight differential patterns of adherence by type of screening program
- We are now exploring the impact/interaction of measures of SES and SDoH on follow-up adherence
- More contextual data associated with the characteristics of a centralized program are needed to understand many of the preliminary findings



Outcomes of Screening

Stage Shift patterns and predictors in Lung Cancer Screening

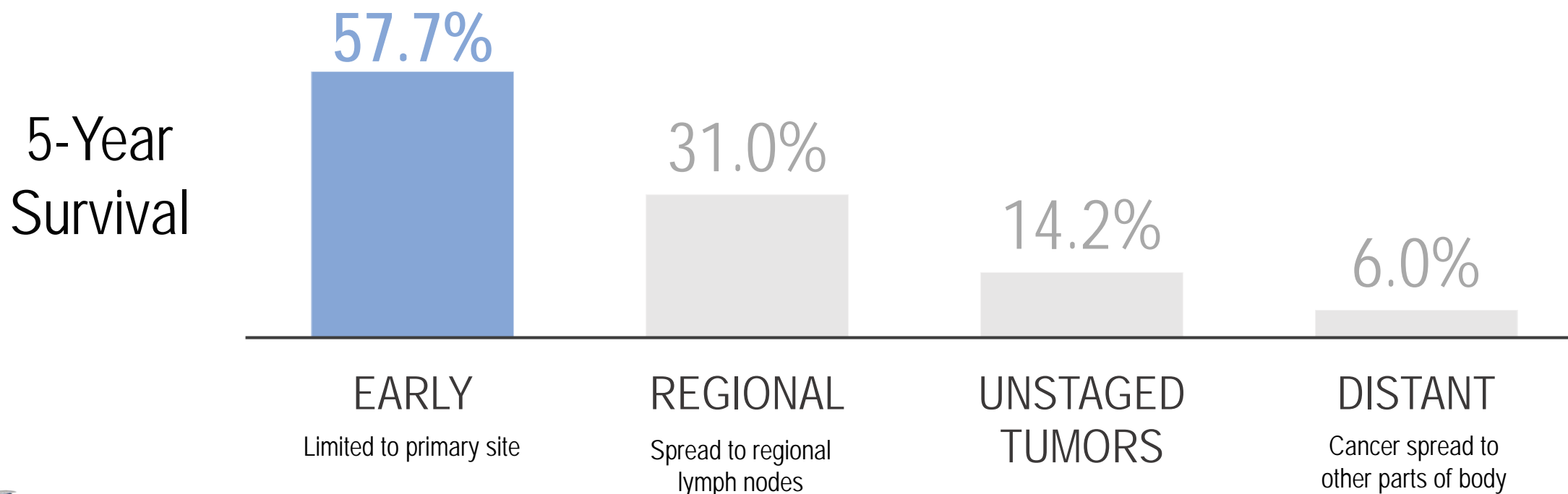
Working Paper. Vachani A, Carroll NM, Simoff M, Ritzwoller DP

Background and Objectives

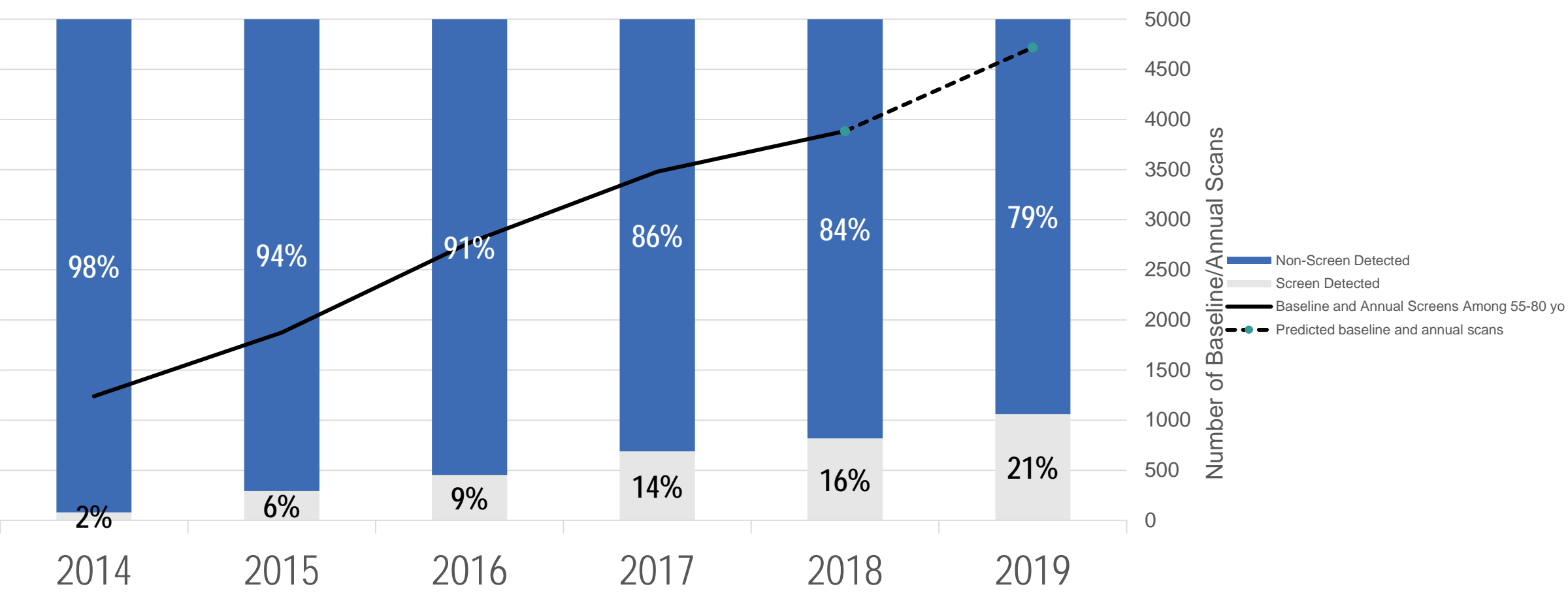
- Evidence suggests that the majority of screen detected lung cancers are diagnosed at an early stage
- Assess the impact of LDCT LCS on lung cancer stage over time
- Identify factors, in addition to screening, that increase the likelihood of an early-stage diagnosis

Finding Lung Cancer Earlier Increases 5-Year Survival Rate

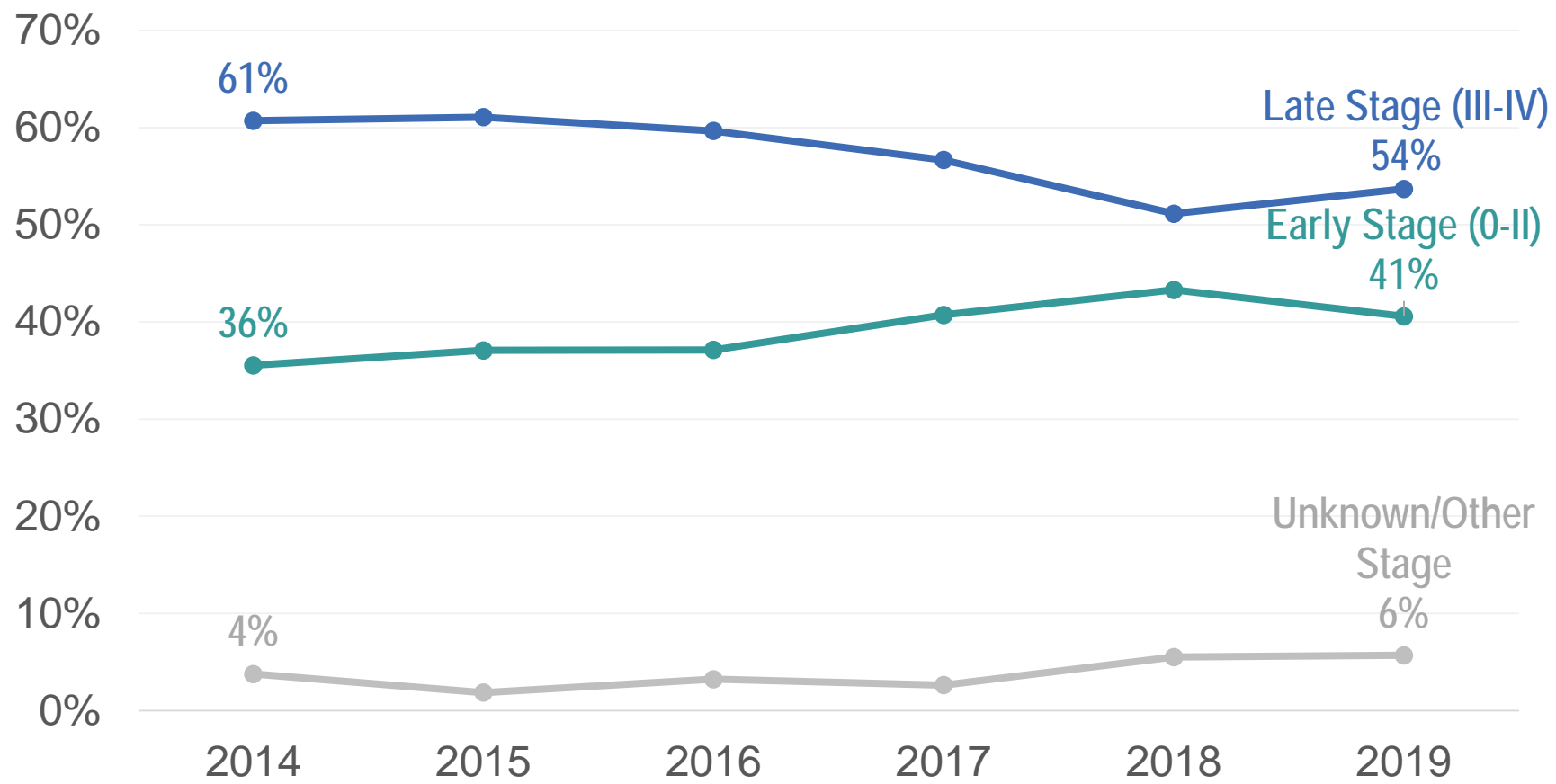
When lung cancer is diagnosed earlier and more treatable stages through LCS, 57 out of every 100 people with lung cancer are still living five years after being diagnosed compared to just 6 people whose cancer spread to other parts of the body.*



More Lung Cancers Detected by Screening Over Time



Overall Shift in Lung Cancers to Earlier, More Treatable Stages



Overall Findings - Takeaway

- Lung Cancers detected after screening were predominantly diagnosed at Stage I or II disease
- A modest decrease in the incidence of advanced stage disease was observed
- Increasing age, female sex, non-small cell histology, former smoking status, having COPD, having a previous non-lung cancer diagnosis, and screening were positively associated with an earlier staged cancer
- Final analyses currently underway



Outcomes of Screening

Evaluating Harms Following Lung Cancer Screening Across Diverse Community-based Healthcare Systems

Greenlee RT, Rendle KA, Burnett-Hartman AN, Lafata JE, Honda S, Kim RY, Neslund-Dudas C, Oshiro C, Wainwright J, Doria-Rose P, Vachani A. (2021, March 29 – April 1). *Evaluating harms following lung cancer screening across diverse community-based healthcare systems* [Poster Presentation]. American Society of Preventive Oncology.

<https://www.eventscribe.net/2021/ASPO/posterspeakers.asp?pfp=Browse%20by%20Speaker>

Objectives

- Identify occurrence of:
 - false positive lung cancer screens in a population of patients receiving LCS in community practice
 - receipt of follow-up imaging and invasive diagnostic procedures after screening
 - post-procedure complications among those undergoing invasive diagnostic procedures after screening



Background

The "Grade B" recommendation (USPSTF) is reflective of the potential harms including false-positives and procedural complications.

- Early experiences suggest LCS-LDCT harms may differ in community settings than NLST
 - Zhao et al. (2020) found that complications were 16.6% overall; and varied by procedure; **nearly 75% greater than the rates** observed in the NLST (9.4%).
 - **Nishi (X) found lower rates of imaging (13.8% vs 21.7%)** but higher rates for certain procedures (but not all) than NLST
- Prior papers limited by use of claims data, no data on rates by cancer, no data on Lung-RADS or false-positives, and no smoking data

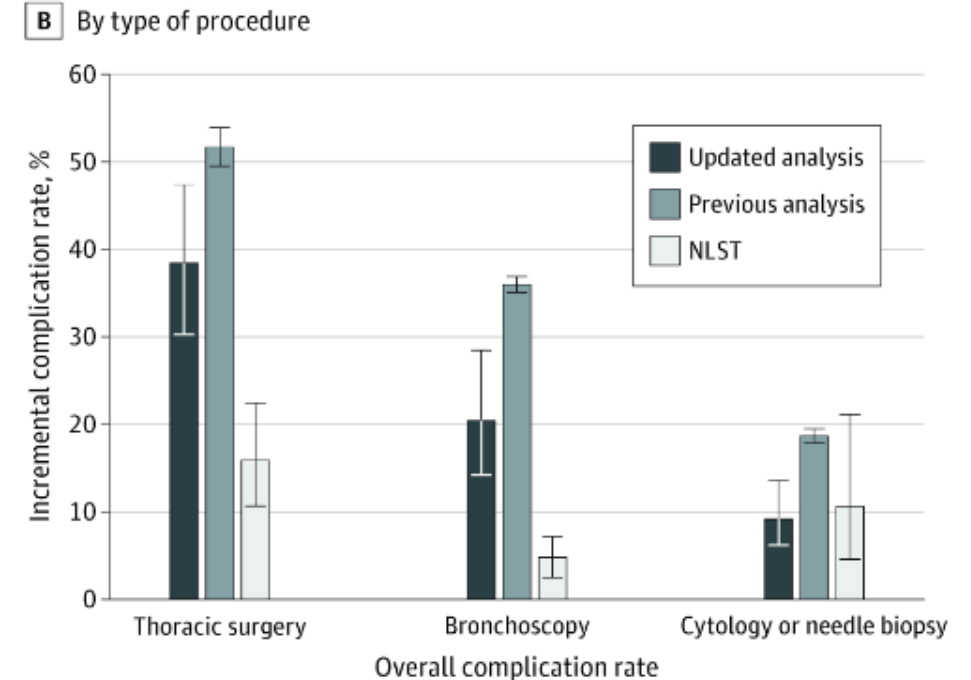


Figure from: Zhao et al. 2020. JAMA Netw Open. 2020;3(12):e2029874.
doi:10.1001/jamanetworkopen.2020.29874



Results

Baseline Positives by False Positive Status

Lung-RADS	# Scans	Cancer @ 12 mos.	%	False Positives	%
3	862	9	1	853	99
4/4A	338	34	10	304	90
4B	141	61	43	80	57
4X	30	20	67	10	33
Total	1371	124	9	1247	91

Invasive Procedures <= 12 mos. post-baseline

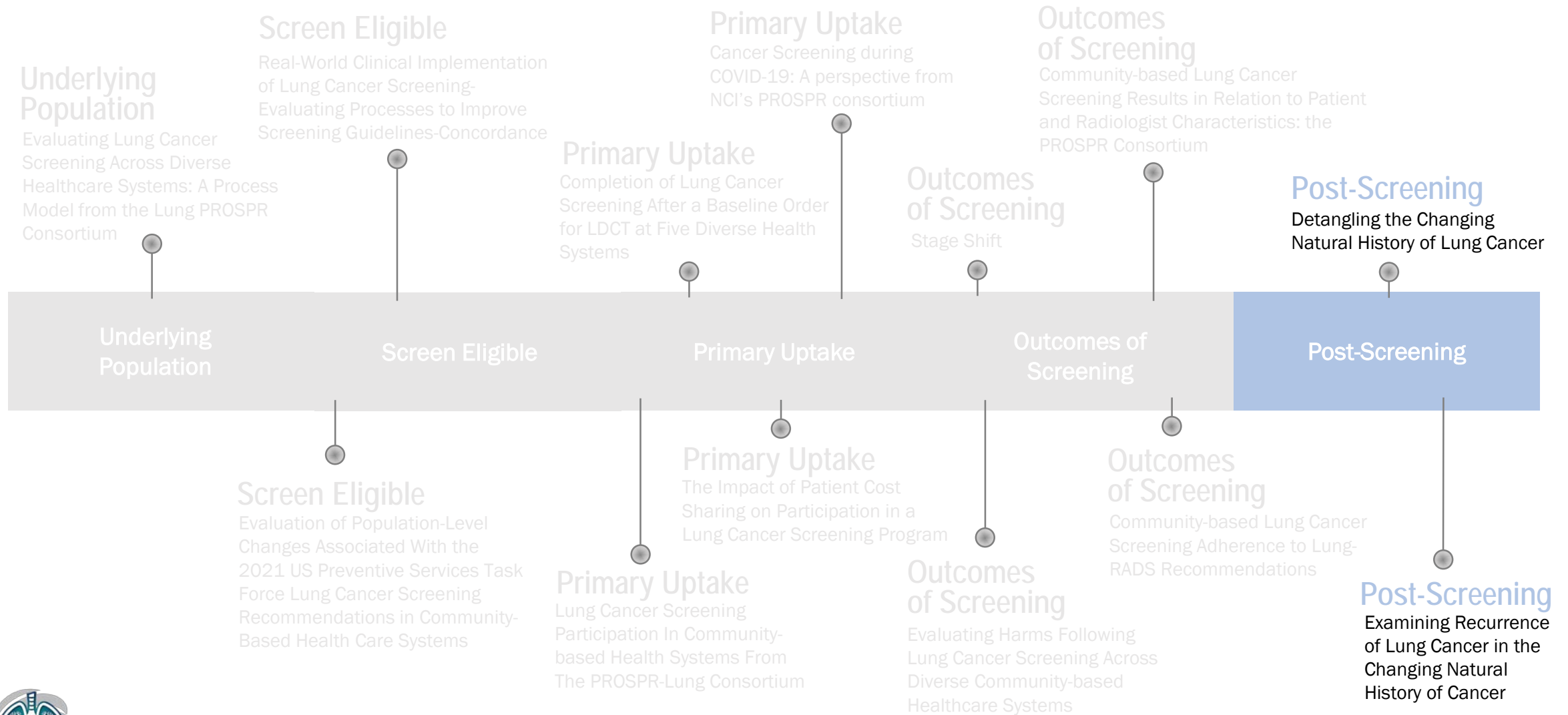
Procedure	#	%
Cytology/Needle Biopsy	403	3
Bronchoscopy	214	2
Thoracic Surgery	124	1
Other Surgical	125	1

Overall Findings - Takeaway

- LCS patients in PROSPR-Lung slightly older at baseline and more likely to be female than trial subjects
- Proportion of positive (*LR3, 4*) baseline scans that were false positives, **91%**, compares favorably to NLST, confirming improvements from Lung-RADS scoring system
- Proportion with invasive diagnostic procedures after baseline LCS similar/slightly higher



Continuum of Lung Cancer Screening



Post-Screening

R50 Extension of PROSPR-Lung*

Detangling the changing natural history of lung cancer

- Screening detecting cancers at an earlier stage
- Decreased incidence of smoking
- Novel treatments extending survival
 - Immunotherapy drugs
 - Targeted drugs
- Improved radiation techniques

* Work in progress under PROSPR-Lung companion grant: National Cancer Institute of the National Institutes of Health Award Number R50CA251966 (PI: Carroll)

Post-Screening

R50 Extension of PROSPR-Lung*

Additional work in progress

- Smoking vs non-smoking related lung cancers
 - Prevalence
 - Survival
- Screen detected vs non-screen detected lung cancers
 - Treatment
 - Recurrence
 - Mortality

* Work in progress under PROSPR-Lung companion grant: National Cancer Institute of the National Institutes of Health Award Number R50CA251966 (PI: Carroll)

Overall Findings

- We've assembled one of the largest lung cancer screening cohorts derived from diverse community-based settings.
- We observed multilevel variation (e.g patient, provider, healthcare system) in the uptake of LCS and variation in the assignment of Lung-RADS.
- Observing indications of shift in stage of lung cancer diagnosis to earlier, more treatable stages.
- Additional multilevel and stratified analyses are currently underway that will help illuminate and hopefully disentangle factors associated with these outcomes.
- Our current effort associated with data collection through 2021 will allow for additional evaluations regarding the impact of the COVID-19 pandemic on LCS.



Current Barriers to Optimal Decomposition of Measures of Disparities

- ❑ Complete and valid capture of tobacco use variables - pack-yrs or CPD and quit date (*former smokers*)
- ❑ Variation along with dynamic changes to LCS programs
 - Centralized vs non-centralized not all characteristics are observable
- ❑ No primary data collection including capture of key measures of SDoH
- ❑ Unobserved variation in Shared Decision Making
- ❑ Unobserved variation in smoking cessation counseling and uptake



Opportunities to Explore Lung Cancer Related Disparities

Insured population with access to high-quality healthcare delivery system, but vary by:

- Insurance payer: direct-pay/exchange, commercial, Medicare, Medicaid
- Cost sharing - high proportion of HDHPs
- Distance to nearest PCP or LCS screening center

SDH and SES proxies: Capture of Census tract (vs zip code -ala Optum) level

- Composite indices including Yost, Neighborhood isolation/deprivation, etc.

Comorbidity capture

Follow-up after negative or positive screen

- Who: PCP/Pulmonology/Oncology/Thor surg
- What: dx imaging, surg and bronchoscopy procedures

Lung Cancer diagnosis

- Stage, grade, histology, etc. e.g. NAACR vars
- Recurrence (potential treatment quality proxy)

Vital status

Lung Cancer treatment

- Uptake of new targeted & immunotherapies



Thank you!

Questions?



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