Supplemental Online Content

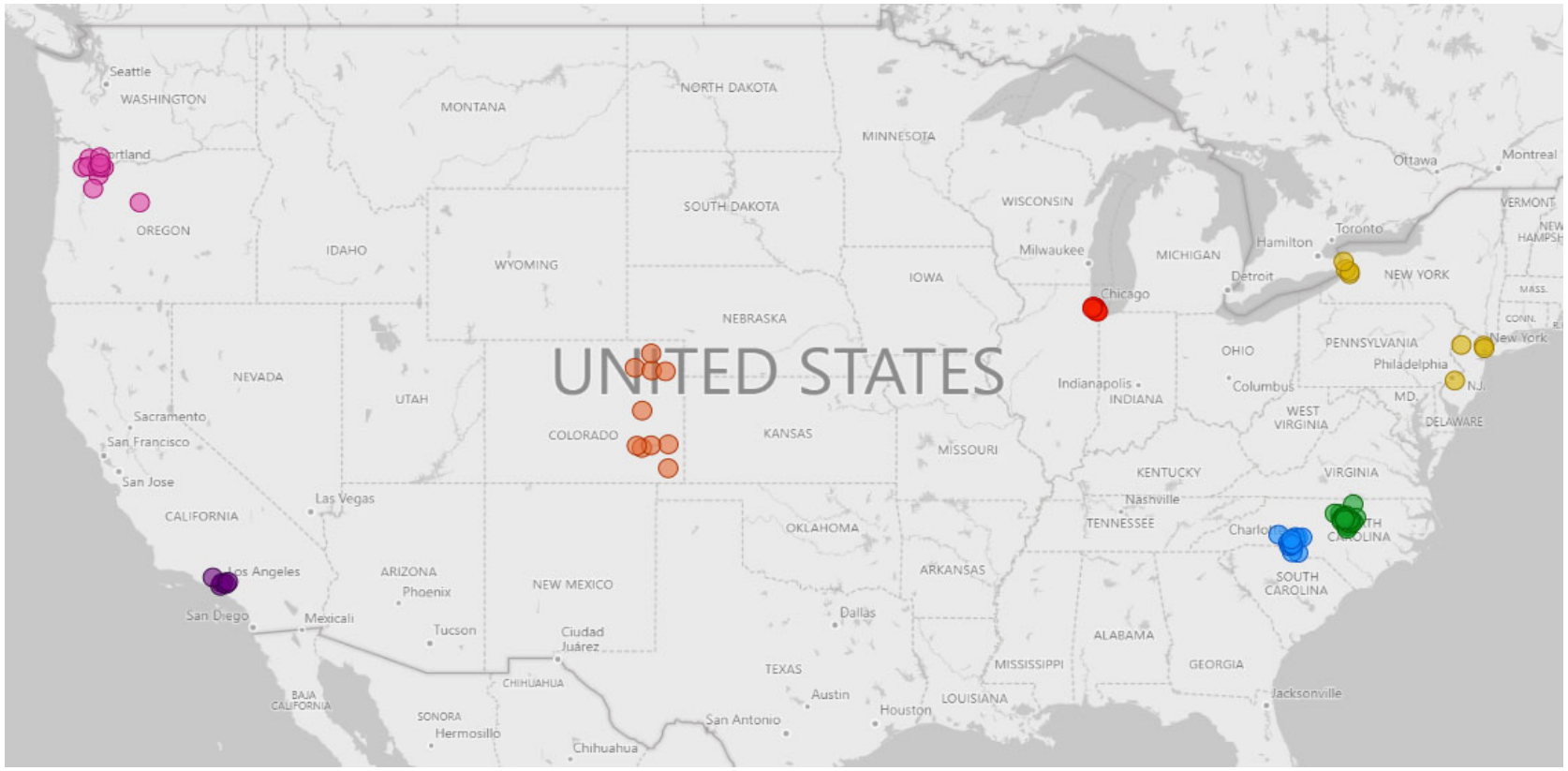
Martinez FJ, Han MK, Lopez C, et al; CAPTURE Study Group. Discriminative accuracy of the CAPTURE tool for identifying chronic obstructive pulmonary disease in US primary care settings. *JAMA*. Published February 14, 2023. doi:10.1001/jama.2023.0128

This supplemental material has been provided by the authors to give readers additional information about their work.

eAbbreviations

AUC	Area under curve
BMI	Body mass index
CI	Confidence interval
DO	Doctor of osteopathy
GED	General Educational Development
ICS	Inhaled corticosteroid
LABA	Long-acting beta agonist
LAMA	Long-acting muscarinic antagonist
mMRC	modified Medical Research Council
NP	Nurse practitioner
OR	Odds ratio
PA	Physician assistant
PBRN	Practice-based research network
PEFR	Peak expiratory flow rate
ROC	Receiver operating characteristic
SABD	Short-acting bronchodilator
SD	Standard deviation

eFigure 1. Geographic distribution of participating PBRNs



CC – Circuit Clinical Research Network (●); Duke PCRC – Primary Care Research Consortium (●); MAPPR – Mecklenburg Area Partnership for Primary Care Research – Atrium (●); ORPRN – Oregon Rural Practice-based Research Network (●); UIC PBRN – University of Illinois at Chicago Primary Care Network (●); LA Net – Los Angeles Network (●); High Plains Research Network (●).

eFigure 2. The CAPTURE screening tool[1]

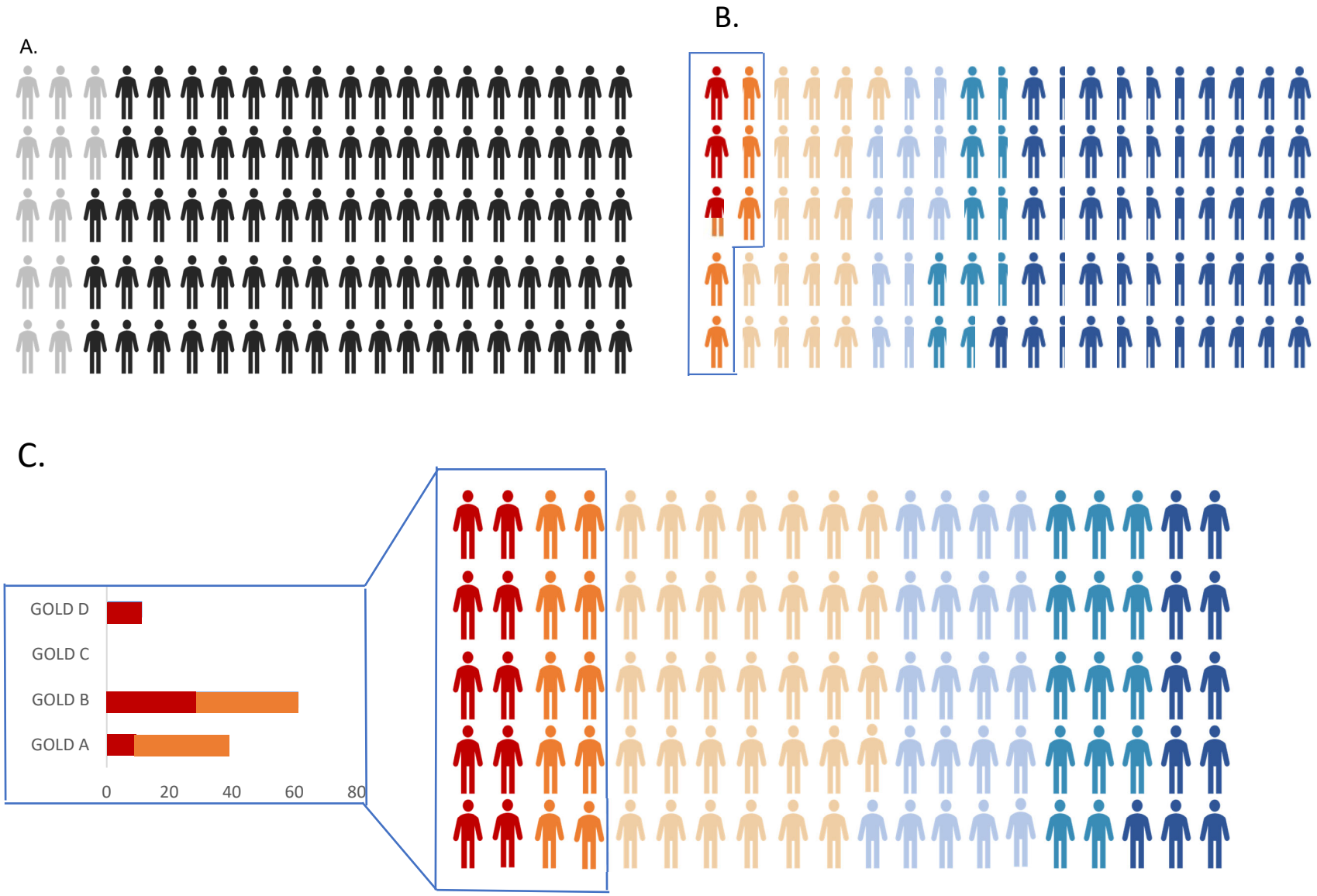
For each question, place an X in the box with the answer that is best for you. There are no right or wrong answers, only answers which are right for you.

Please answer each question	**No** *(0 points)*	**Yes** *(1 point)*	
1. Have you ever lived or worked in a place with dirty or polluted air, smoke, second-hand smoke, or dust?	☐	☐	
2. Does your breathing change with the seasons, weather, or air quality?	☐	☐	
3. Does your breathing make it difficult to do such things as carry heavy loads, shovel dirt or snow, jog, play tennis, or swim?	☐	☐	
4. Compared to others your age, do you tire easily?	☐	☐	
5. In the past 12 months, how many times did you miss work, school, or other activities due to a cold, bronchitis, or pneumonia?	**None** *(0 points)* ☐	**Once** *(1 point)* ☐	**2 or more** *(2 points)* ☐

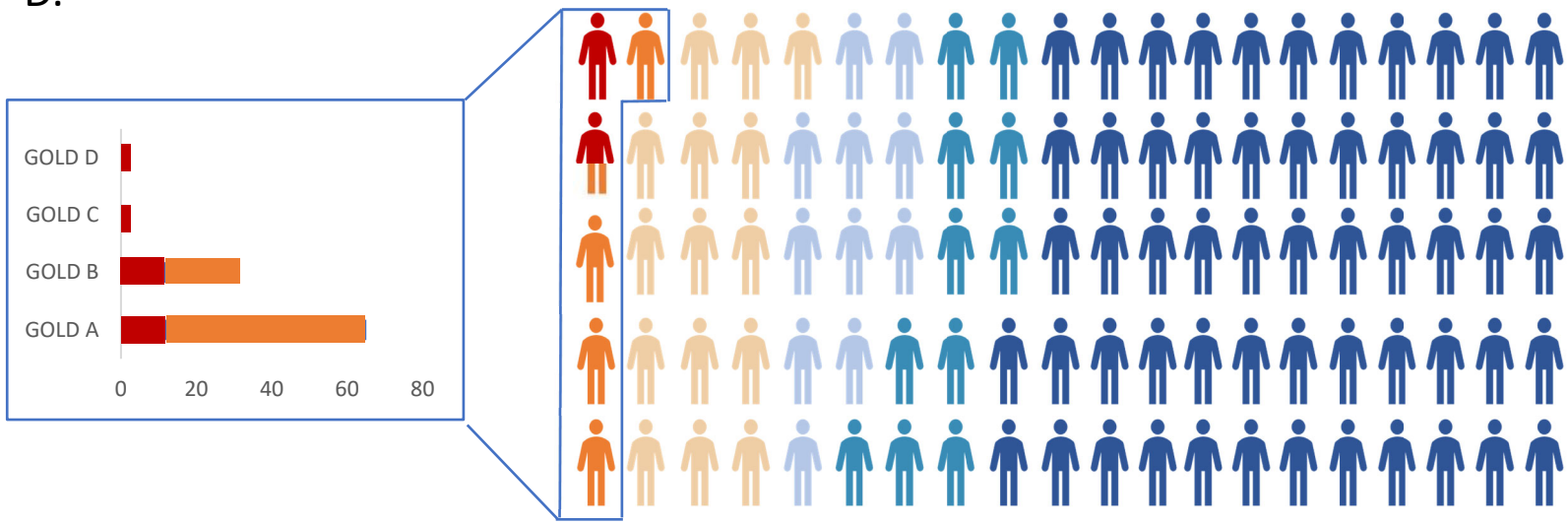
Total Score (0-6): _____

Total Score (check **ONLY one box** based on above score)			**RECOMMENDED ACTION:**
0 or 1 ☐			**A.** Low likelihood of COPD based on CAPTURE: No further testing recommended at this time
2, 3, or 4 Record Highest Peak Flow (highest of 3): _____ L/min	(check one based on highest Peak Flow)		
	Females ≥ 250 L/min Males ≥ 350 L/min	☐	**B.** Consider rescreening or reassessing in 12 months
	Females < 250 L/min Males < 350 L/min	☐	**C.** Evaluation including spirometry recommended
5 or 6 ☐			**D.** Significant likelihood of COPD: Evaluation including spirometry recommended

eFigure 3. Screening results and classification of patients based on spirometry and symptom assessment



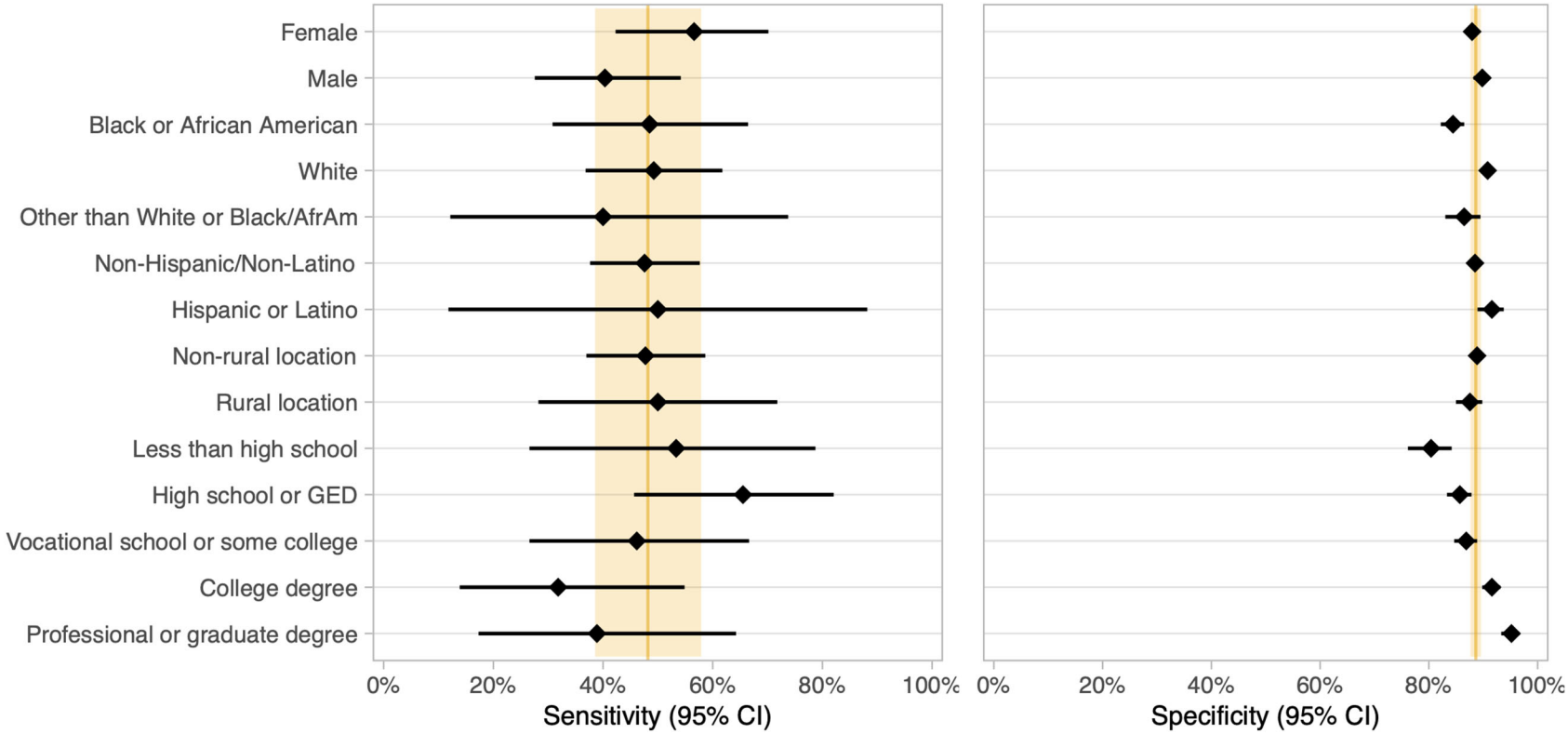
D.



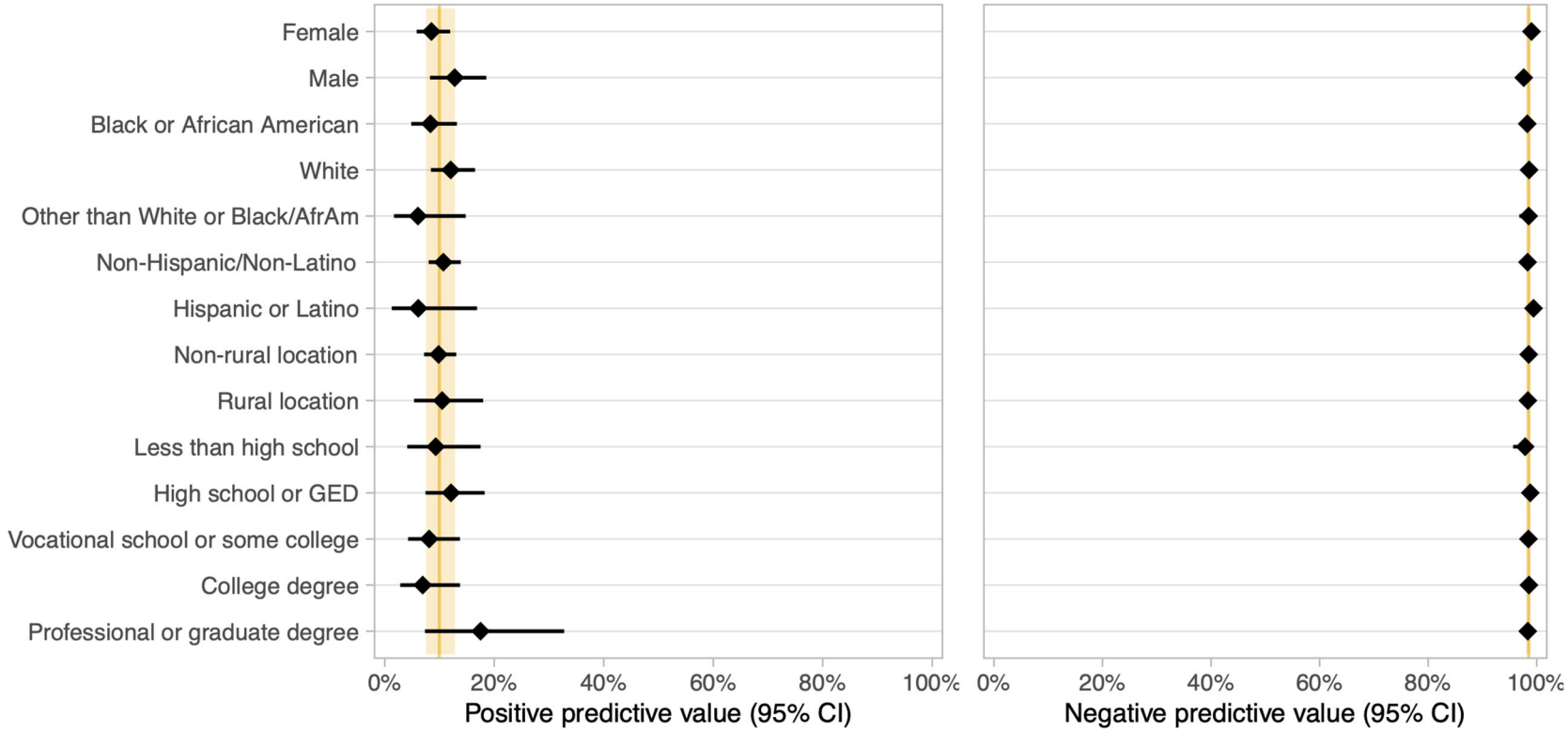
Clinically significant COPD ( ); non-clinically significant COPD ( ); preserved ratio, impaired spirometry (PRISm,); symptomatic, normal spirometry, former or current smoker ( ); symptomatic, normal spirometry, never smoker ( ); normal spirometry without symptoms ( ). Normal spirometry is defined as absence of COPD and PRISm. Symptomatic is defined as a CAT score ≥ 10.

A. Prevalence of screening tool positive ( ) and screening tool negative ( ) per 100 total patients. Screening tool positive: 12.3% of all patients; Screening tool negative: 87.7% of all patients.
B. Prevalence by diagnosis and symptoms per 100 patients. For all study patients, 2.5% clinically significant COPD; 5.2% non-clinically significant COPD; 17.8% preserved ratio, impaired spirometry (PRISm); 12.0% symptomatic, normal spirometry, former or current smoker; 11.4% symptomatic, normal spirometry, never smoker; 51.1% normal spirometry without symptoms.
C. Prevalence by diagnosis and symptom classification per 100 screening tool positive patients. The call out illustrates GOLD stage by the presence of clinically significant COPD ( ) or non-clinically significant COPD ( ).
D. Prevalence by diagnosis and symptom classification for 100 screening tool negative patients. The call out illustrates GOLD stage by the presence of clinically significant COPD ( ) or non-clinically significant COPD ( ).

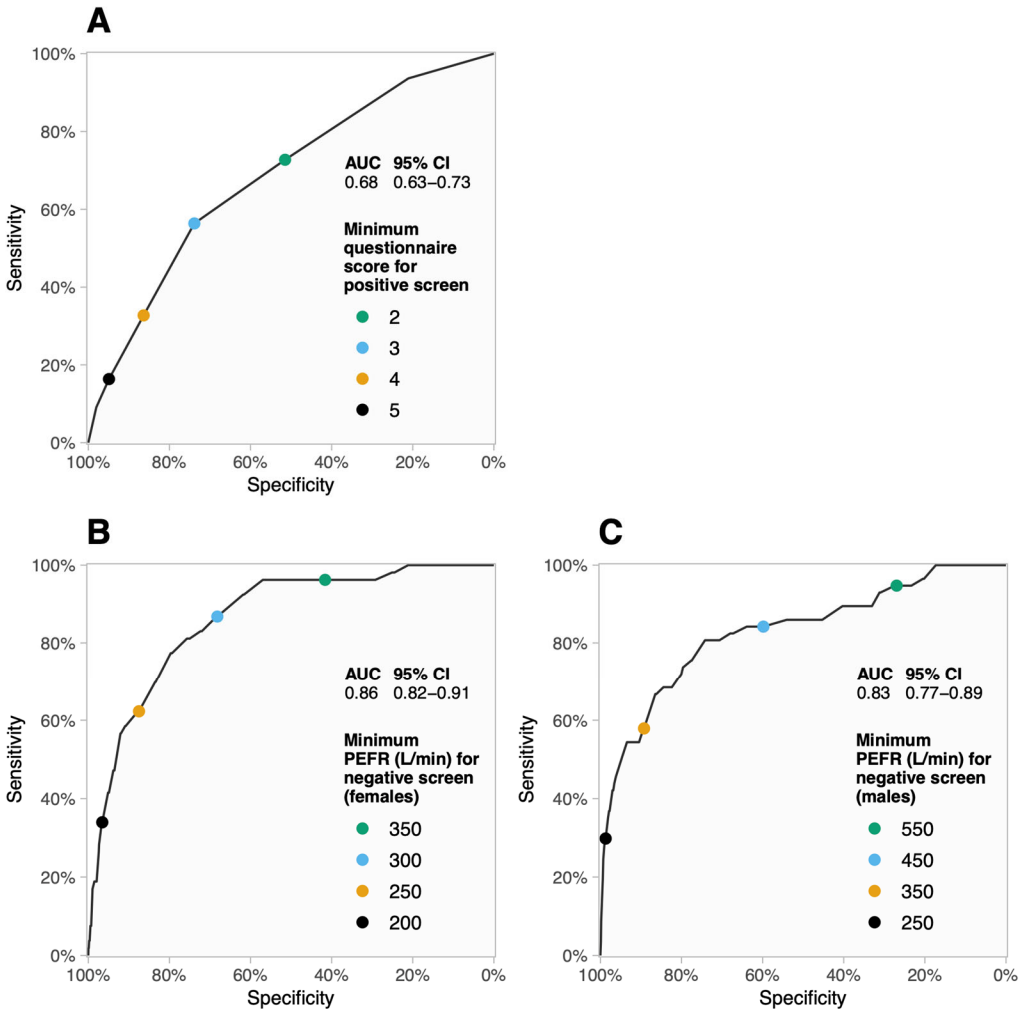
eFigure 4. Sensitivity and specificity of the screening tool for clinically significant COPD in pre-specified subgroups



eFigure 5. Positive and negative predictive value of the screening tool for clinically significant COPD in pre-specified subgroups

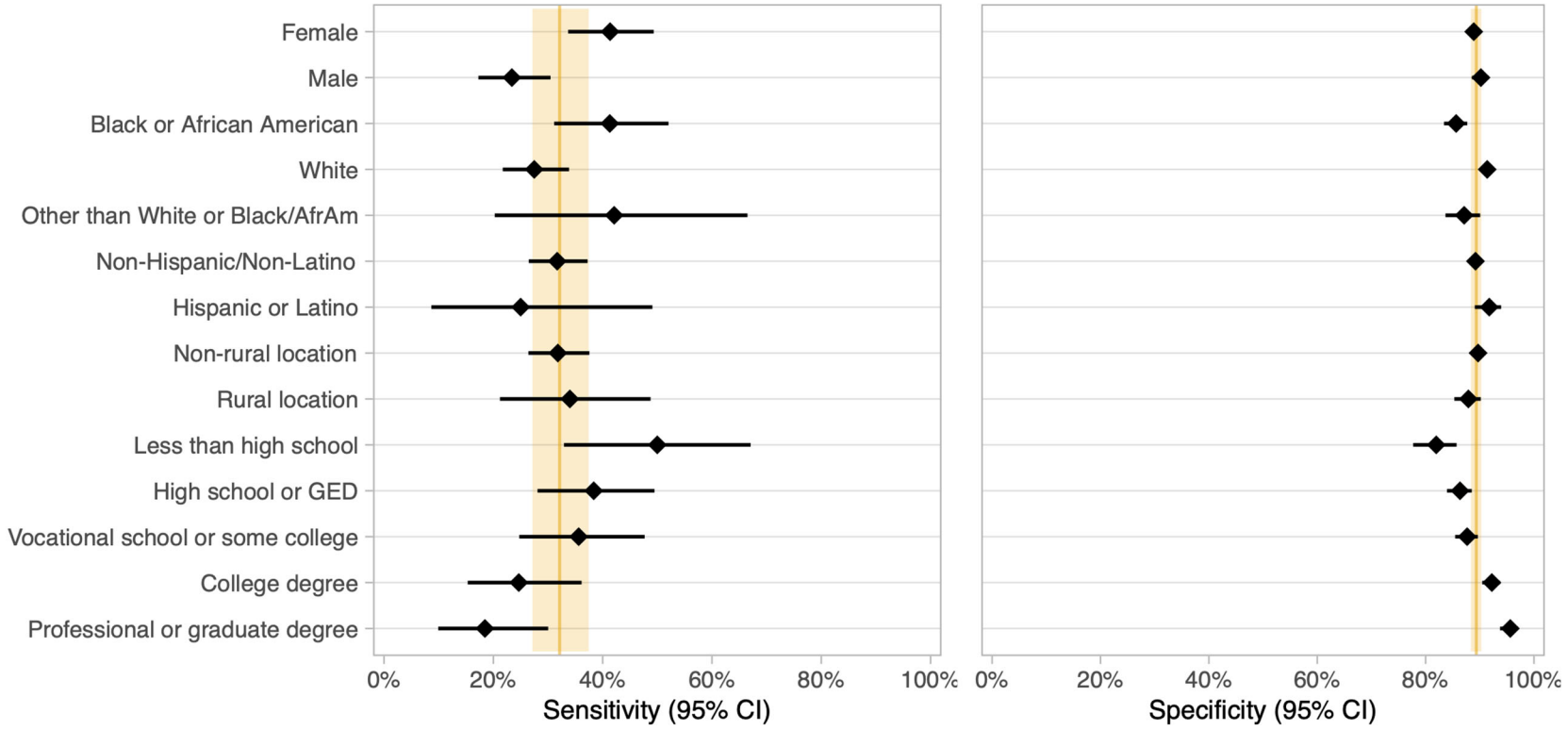


eFigure 6. ROC curves for varying thresholds of the CAPTURE questionnaire score and PEFR separately to detect clinically significant COPD

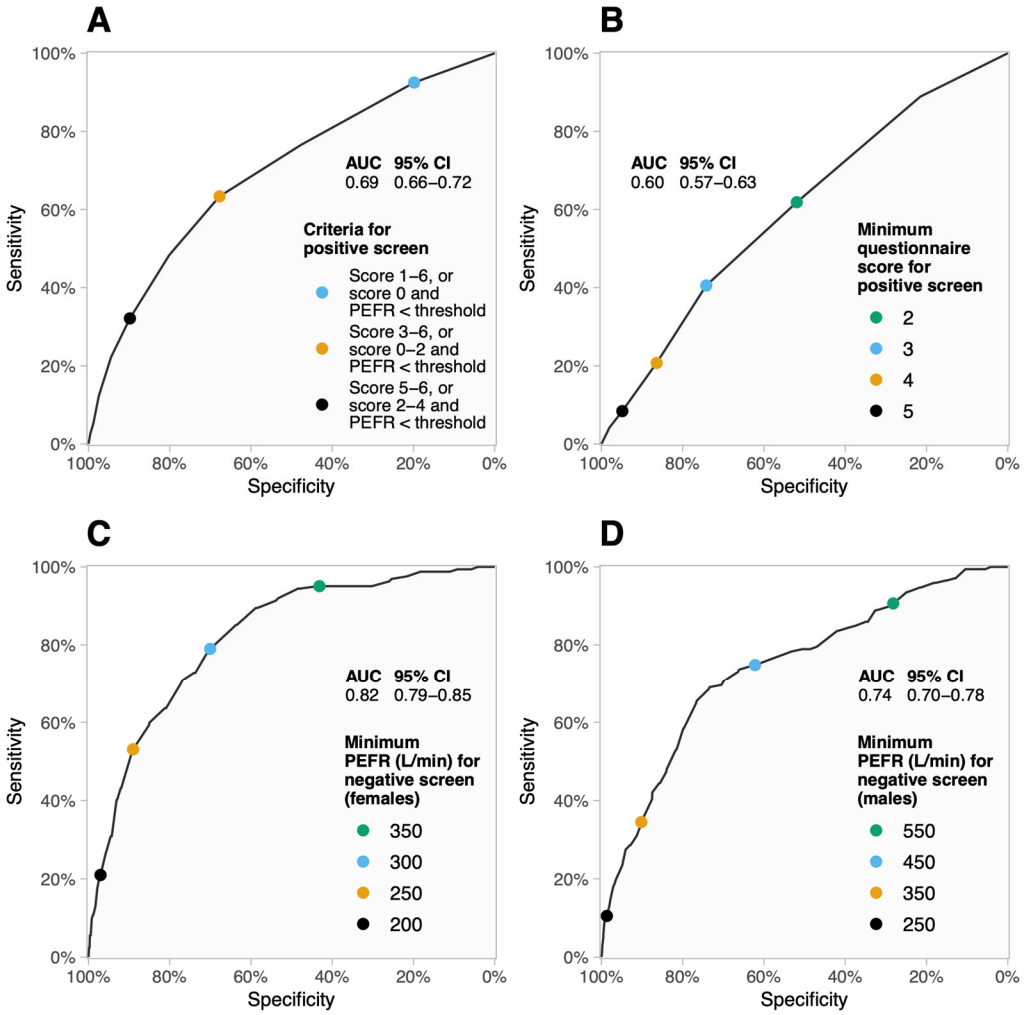


ROC curves formed by defining a positive screen based on (A) the CAPTURE questionnaire score alone, (B) PEFR alone in female patients, and (C) PEFR alone in male patients.

eFigure 7. Sensitivity and specificity of the screening tool for spirometry-defined COPD in pre-specified subgroups

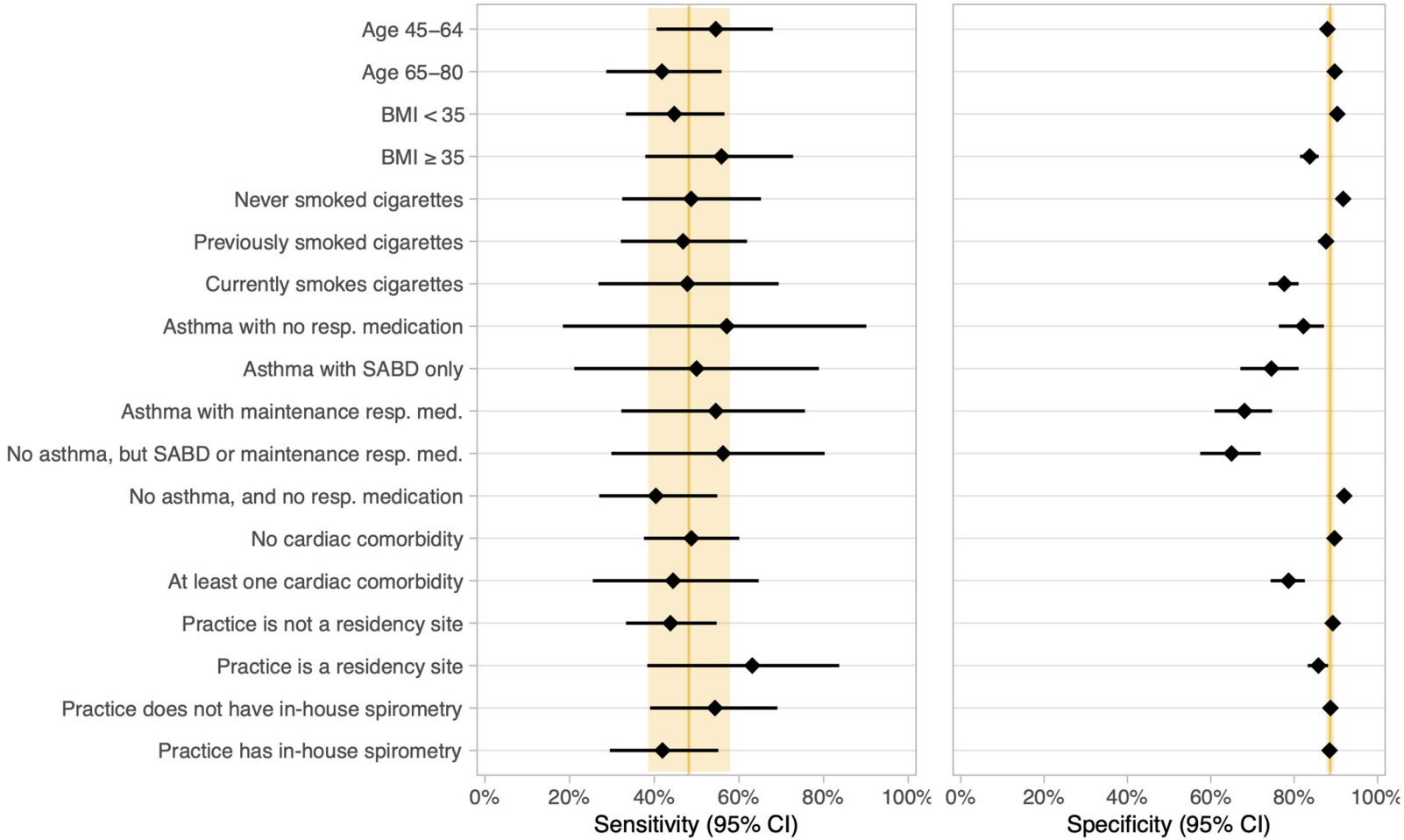


eFigure 8. ROC curves for varying thresholds defining a positive screen to detect spirometry-defined COPD

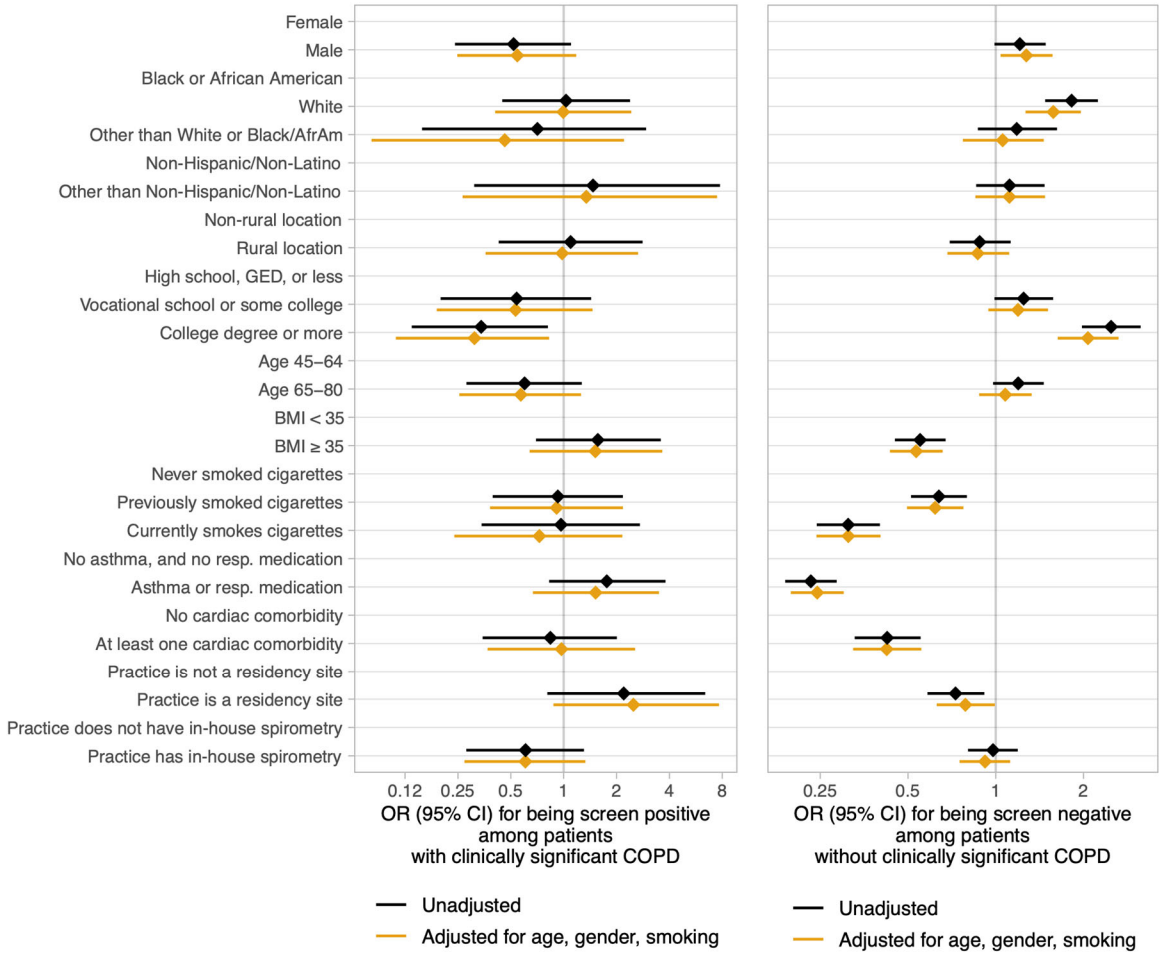


ROC curves formed by defining a positive screen based on (A) the CAPTURE questionnaire score combined with PEFR (thresholds of < 250 L/min for females and < 350 L/min for males), (B) the questionnaire score alone, (C) PEFR alone in female patients, and (D) PEFR alone in male patients.

eFigure 9. Sensitivity and specificity of the screening tool for clinically significant COPD in additional subgroups



eFigure 10. Unadjusted and covariate-adjusted associations of patient and site characteristics with screening tool sensitivity and specificity for clinically significant COPD



Odds ratios (ORs) were estimated and adjusted for age (≥ 65 vs < 65 years), gender, and smoking status (never, former, current) using logistic regression.

eTable 1. Characteristics of participating practices

Characteristic	Number
PBRN	
Mecklenburg Area Partnership for Primary Care Research - Atrium	20 practices / 936 patients
Duke Primary Care Research Consortium	26 practices / 1298 patients
High Plains Research Network	14 practices / 611 patients
LA Net Community Health Resource Network	6 practices / 281 patients
Oregon Rural Practice-based Research Network	11 practices / 468 patients
University of Illinois Chicago PBRN	13 practices / 650 patients
Circuit Clinical Integrated Research Organization	10 practices / 435 patients
Practice location[a]	
Non-rural	82 (82.0%)
Rural	18 (18.0%)
Patients ages 45-80 seen over past 12 mo.[b]	
Mean (SD)	6440 (8829)
Range	79 - 61227
Practice description[b]	
Large health system, accountable care organization, or similar	35 (35.7%)
Academic medical center/health system	28 (28.6%)
Federally Qualified Health Care Center	18 (18.4%)
Independent practice	10 (10.2%)
Other	7 (7.1%)
Residency program[b]	
No	78 (79.6%)
Yes	20 (20.4%)
Population of the community served[b]	
< 2,000	4 (4.1%)
2,000 to 4,999	5 (5.1%)
5,000 to 19,999	16 (16.3%)
20,000 to 49,999	13 (13.3%)
50,000 to 99,999	12 (12.2%)
100,000 to 249,999	5 (5.1%)
250,000 to 499,999	15 (15.3%)
≥ 500,000	28 (28.6%)
Number of clinicians at site, MD/DO, primary care[c]	
Mean (SD)	6 (7)
Range	0 - 43

Characteristic	Number
Number of clinicians at site, NP/PA, primary care[c]	
Mean (SD)	2 (2)
Range	0 - 9
In-house spirometry available[b]	
No	40 (40.8%)
Yes	58 (59.2%)
Distance to nearest pulmonary rehabilitation program[b]	
Within 15 miles	69 (70.4%)
16 to 30 miles	11 (11.2%)
31 to 50 miles	2 (2.0%)
More than 50 miles	5 (5.1%)
Virtual program utilized	2 (2.0%)
Don’t know	9 (9.2%)

[a] Human Resources & Services Administration designation based on zip code
[b] 2 missing values
[c] 4 missing values

eTable 2. Characteristics of excluded and included patients

Characteristic	Excluded participants (n = 354)	Included participants (n = 4325)	P-value
Age, years, mean (SD)	61.5 (9.6)	61.6 (9.1)	0.90
Gender, n (%)			0.11
Female	203 (58.7%)	2725 (63.0%)	
Male	143 (41.3%)	1600 (37.0%)	
BMI ≥ 30 kg/m^2, n (%)	169 (50.0%)	2159 (49.9%)	0.98
Ethnicity, n (%)			0.03
Non-Hispanic/non-Latino	274 (79.2%)	3654 (84.6%)	
Hispanic or Latino	58 (16.8%)	553 (12.8%)	
Don't know/Prefer not to answer	14 (4.0%)	114 (2.6%)	
Race, n (%)			<0.001
American Indian/Alaska Native	5 (1.4%)	48 (1.1%)	
Asian	3 (0.9%)	77 (1.8%)	
Black or African American	82 (23.8%)	1164 (26.9%)	
Native Hawaiian/Other Pacific Islander	1 (0.3%)	8 (0.2%)	
White	202 (58.6%)	2689 (62.2%)	
Multiple races	13 (3.8%)	49 (1.1%)	
Don't know/Prefer not to answer	39 (11.3%)	287 (6.6%)	
Education, n (%)			0.03
Less than high school	50 (14.6%)	413 (9.6%)	
High school or GED	85 (24.9%)	994 (23.0%)	
Vocational school or some college	76 (22.2%)	1062 (24.6%)	
College degree	84 (24.6%)	1140 (26.4%)	
Professional or graduate degree	47 (13.7%)	704 (16.3%)	
Employment, n (%)			0.03
Not working due to disability	56 (16.3%)	524 (12.1%)	
Not working for reason other than disability	154 (44.8%)	1858 (43.0%)	
Working part- or full-time	134 (39.0%)	1935 (44.8%)	
Health insurance, n (%)			0.02
Private	111 (32.1%)	1564 (36.2%)	
Public	152 (43.9%)	1587 (36.7%)	
Both Public and Private	63 (18.2%)	981 (22.7%)	
None	16 (4.6%)	132 (3.1%)	
Other/Don't Know	4 (1.2%)	61 (1.4%)	
Asthma diagnosis and respiratory medications, n (%)			0.09

Characteristic	Excluded participants (n = 354)	Included participants (n = 4325)	P-value
No asthma history, and not using any respiratory medications	283 (80.9%)	3527 (81.7%)	
No asthma history, but using at least one respiratory medication	18 (5.1%)	193 (4.5%)	
Asthma history, and not using any respiratory medications	27 (7.7%)	215 (5.0%)	
Asthma history, and using SABD only	12 (3.4%)	173 (4.0%)	
Asthma history, and using daily maintenance respiratory medication	10 (2.9%)	210 (4.9%)	
Asthma diagnosis, n (%)	49 (14.0%)	599 (13.9%)	0.96
Cardiac comorbidity[a], n (%)	38 (10.8%)	430 (10.0%)	0.60
Cigarette smoking, n (%)			
Never	187 (53.3%)	2391 (55.4%)	0.33
Former	108 (30.8%)	1359 (31.5%)	
Current	56 (16.0%)	568 (13.2%)	
Short-acting bronchodilator, n (%)	34 (9.7%)	493 (11.4%)	0.33
Maintenance respiratory medication, n (%)			
None	336 (95.7%)	4047 (93.6%)	0.41
ICS alone	1 (0.3%)	86 (2.0%)	
LABA or LAMA alone	0 (0.0%)	7 (0.2%)	
LABA and ICS	13 (3.7%)	166 (3.8%)	
LAMA and ICS	0 (0.0%)	2 (0.0%)	
LABA and LAMA	0 (0.0%)	2 (0.0%)	
LABA, LAMA, and ICS	1 (0.3%)	12 (0.3%)	
COPD Assessment Test (CAT) score ≥ 10, n (%)	109 (32.2%)	1570 (36.3%)	0.13
Walks slower than others or stops for breath (mMRC ≥ 2), n (%)	47 (13.4%)	651 (15.1%)	0.40
Acute respiratory illness in past 12 months[b], n (%)	28 (8.0%)	405 (9.4%)	0.39
CAPTURE 5-item score, mean (SD)	1.7 (1.4)	1.8 (1.5)	0.62
Criteria used in determining CAPTURE screen result, n (%)			0.29
Score 0–1	178 (52.4%)	2200 (50.9%)	
Score 2–4, PEFR ≥ threshold	123 (36.2%)	1593 (36.8%)	
Score 2–4, PEFR < threshold	28 (8.2%)	299 (6.9%)	
Score 5–6	11 (3.2%)	233 (5.4%)	
PEFR (L/min), mean (SD)	376 (114)	379 (114)	0.62

[a] – Any of the following: angina (heart/chest pain), coronary artery disease, heart attack (MI), coronary artery bypass surgery (CABG), angioplasty/cardiac stents, congestive heart failure
[b] – Queried as ‘Over the last 12 months, have you had episodes of chest troubles (cough, phlegm, or shortness of breath) requiring treatment with antibiotics and/or steroids?’

eTable 3. Operating characteristics of the screening tool for detecting clinically significant COPD across a range of thresholds defining a positive screen

Definition of positive screen	Require PEFR for scoring (%)	Screen positive (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
N/A (all screen negative)	0.0	0.0	0.0	100.0	-	97.5
Score 6 with PEFR < threshold	2.2	0.6	6.4	99.5	25.0	97.6
Score 5–6 with PEFR < threshold	5.4	1.5	10.0	98.7	17.2	97.7
Score 4–6 with PEFR < threshold	14.1	3.3	20.0	97.1	15.4	97.9
Score 6, or score 3–5 with PEFR < threshold	24.8	6.8	35.5	93.9	13.2	98.2
Score 5–6, or score 2–4 with PEFR < threshold	43.7	11.9	48.2	89.1	10.3	98.5
Score 4–6, or score 1–3 with PEFR < threshold	65.2	22.1	67.3	79.1	7.7	98.9
Score 3–6, or score 0–2 with PEFR < threshold	73.1	34.7	83.6	66.6	6.1	99.4
Score 2–6, or score 0–1 with PEFR < threshold	50.9	54.2	90.9	46.7	4.3	99.5
Score 1–6, or score 0 with PEFR < threshold	20.7	81.1	99.1	19.4	3.1	99.9
Score 0–6 (all screen positive)	0.0	100.0	100.0	0.0	2.5	-

eTable 4. Unadjusted and covariate-adjusted associations of patient and site characteristics with screening tool sensitivity and specificity for clinically significant COPD

	Association with positive screening result among patients with clinically significant COPD (sensitivity)		Association with negative screening result among patients without clinically significant COPD (specificity)	
Variable	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Gender				
Female	-	-	-	-
Male	0.52 (0.24, 1.10)	0.54 (0.25, 1.18)	1.21 (0.99, 1.48)	1.27 (1.04, 1.57)
Race				
White	-	-	-	-
Black or African American	0.97 (0.42, 2.24)	1.01 (0.41, 2.46)	0.55 (0.45, 0.68)	0.63 (0.51, 0.79)
Other than White or Black/African American	0.69 (0.16, 2.62)	0.46 (0.09, 2.05)	0.65 (0.48, 0.88)	0.67 (0.50, 0.92)
Ethnicity				
Non-Hispanic/non-Latino	-	-	-	-
Other than non-Hispanic/Non-Latino	1.47 (0.31, 7.77)	1.35 (0.27, 7.47)	1.11 (0.86, 1.47)	1.11 (0.85, 1.48)
Practice location				
Non-rural	-	-	-	-
Rural	1.10 (0.43, 2.81)	0.98 (0.36, 2.65)	0.88 (0.70, 1.13)	0.87 (0.68, 1.11)
Education				
High school, GED or less	-	-	-	-
Vocational school or some college	0.54 (0.20, 1.43)	0.53 (0.19, 1.46)	1.25 (0.99, 1.57)	1.19 (0.94, 1.51)
College degree or more	0.34 (0.14, 0.81)	0.31 (0.11, 0.83)	2.49 (1.98, 3.14)	2.07 (1.63, 2.64)
Age				
45–64	-	-	-	-
65–80	0.60 (0.28, 1.27)	0.57 (0.25, 1.26)	1.19 (0.98, 1.46)	1.08 (0.88, 1.33)
BMI				
< 35	-	-	-	-
≥ 35	1.56 (0.70, 3.57)	1.51 (0.64, 3.65)	0.55 (0.45, 0.67)	0.53 (0.43, 0.66)
Cigarette smoking				
Never	-	-	-	-
Former	0.93 (0.39, 2.17)	0.91 (0.38, 2.18)	0.64 (0.51, 0.80)	0.62 (0.50, 0.77)
Current	0.96 (0.34, 2.72)	0.73 (0.24, 2.16)	0.31 (0.24, 0.40)	0.31 (0.24, 0.40)
Asthma and respiratory medication				
No asthma history, and no respiratory medication	-	-	-	-
Asthma history or at least one respiratory medication	1.76 (0.83, 3.80)	1.52 (0.67, 3.49)	0.23 (0.19, 0.28)	0.24 (0.20, 0.30)

	Association with positive screening result among patients with clinically significant COPD (sensitivity)		Association with negative screening result among patients without clinically significant COPD (specificity)	
Variable	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Cardiac comorbidity				
None	-	-	-	-
At least one	0.84 (0.35, 2.01)	0.97 (0.37, 2.55)	0.42 (0.33, 0.55)	0.42 (0.32, 0.56)
Practice has a residency program				
No	-	-	-	-
Yes	2.20 (0.81, 6.40)	2.49 (0.87, 7.67)	0.73 (0.58, 0.91)	0.79 (0.63, 0.99)
Practice has in-house spirometry				
No	-	-	-	-
Yes	0.61 (0.28, 1.30)	0.60 (0.27, 1.33)	0.98 (0.80, 1.19)	0.92 (0.75, 1.12)

Odds ratios (ORs) were estimated and adjusted for age ($\geq$ 65 vs < 65 years), gender, and smoking status (never, former, current) using logistic regression.

eReference

1. Martinez FJ, Mannino D, Leidy NK, et al. A New Approach for Identifying Patients with Undiagnosed Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med*. Mar 15 2017;195(6):748-756. doi:10.1164/rccm.201603-0622OC