

Evaluating Knowledge, Attitudes, and Beliefs About Lung Cancer Screening Using Crowdsourcing

John Monu, MD; Matthew Triplette, MD, MPH; Douglas E. Wood, MD; Erika M. Wolff, PhD; Danielle C. Lavalley, PharmD, PhD; David R. Flum, MD, MPH; and Farhood Farjah, MD, MPH

CHEST 2020; 158(1):386-392

Online supplements are not copyedited prior to posting and the author(s) take full responsibility for the accuracy of all data.

© 2020 AMERICAN COLLEGE OF CHEST PHYSICIANS. Reproduction of this article is prohibited without written permission from the American College of Chest Physicians. See online for more details. DOI: 10.1016/j.chest.2019.12.048

e-Appendix 1: Survey Questions and Responses by Individuals at High-Risk for Lung Cancer Based on USPSTF Criteria (n=240)

Question 1

Has your doctor ever told you that you have any of the following? Check all that apply.

- Lung cancer - **0 (0%)**
- Any other cancer (except for basal cell or squamous cell skin cancer) - **8 (3.3%)**
- COPD or emphysema - **43 (17%)**
- Pulmonary fibrosis or IPF - **2 (0.8%)**
- No, I have never been told I have any of the above - **195 (81%)**

Question 2

Are you currently on long-term home oxygen therapy?

- Yes - **0 (0%)**
- No - **240 (100%)**

Question 3

Which of the following have you ever had major contact with, either at work or at home? Check all that apply.

- Radon - **6 (2.1%)**
- Silica - **7 (2.5%)**
- Cadmium - **3 (1.1%)**
- Asbestos - **40 (14%)**
- Arsenic - **3 (1.1%)**
- Beryllium - **3 (1.1%)**
- Chromium - **4 (1.4%)**
- Diesel fumes - **38 (13%)**
- Nickel - **2 (0.7%)**
- I do not think I have ever had major contact with any of the above - **164 (58%)**
- I don't know - **15 (5.3)**

Question 4

Do you have any first-degree relatives (parents, siblings or children) who have/had lung cancer?

- Yes - **60 (25%)**
- No - **180 (75%)**

Question 5

True or false: There is a test doctors can use to find lung cancer early to improve the chances of curing the cancer

- True - **104 (43%)**
- False - **22 (9.2%)**
- I don't know - **114 (48%)**

Question 5a is shown only to respondents who answer "true" to Question 5

Question 5a

What is the test used to find lung cancer early to improve the chances of curing the cancer?

- Chest X-ray - **28 (27%)**
- Chest CT (CAT) scan - **35 (35%)**
- Chest MRI - **16 (15%)**
- Blood test - **9 (8.7%)**
- I don't know - **16 (16%)**

Question 6

Has a doctor/healthcare provider ever talked to you about getting a test to look for early lung cancer?

- Yes - **33 (14%)**
- No - **207 (86%)**

Question 7

Have you ever had a test to look for early lung cancer?

- Yes - **24 (10%)**
- No - **203 (85%)**
- I don't know - **13 (5.4%)**

If answer is "yes" to Question 7

Question 7a

What test did you have to look for early lung cancer?

- Chest X-ray - **12 (50%)**
- Chest CT (CAT) scan - **12 (50%)**
- Chest MRI - **0 (0%)**
- Blood test - **0 (0%)**

Please indicate how much you agree with the following statements (Strongly agree, Agree, Neutral, Disagree, or Strongly disagree)

Question 8

I believe that tests looking for early cancers are helpful.

- Strongly agree - **144 (60%)**
- Agree - **70 (29%)**
- Neutral - **20 (8.3%)**
- Disagree - **6 (2.5%)**
- Strongly disagree - **0 (0%)**

Question 9

I believe that tests looking for early lung cancer have the potential to save lives.

- Strongly agree - **142 (59%)**
- Agree - **80 (33%)**
- Neutral - **13 (5.4%)**
- Disagree - **5 (2.1%)**
- Strongly disagree - **0 (0%)**

Question 10

I am at a high risk of getting lung cancer.

- Strongly agree - **53 (22%)**
- Agree - **111 (46%)**
- Neutral - **43 (18%)**
- Disagree - **18 (7.5%)**
- Strongly disagree - **6 (2.5%)**
- I don't know - **9 (3.8%)**

The following questions (11-15) will focus on your thoughts about smoking and lung cancer

Question 11

If you obtained a test looking for lung cancer and NO lung cancer was found, would you be motivated to stop smoking?

- Yes - **109 (45%)**
- No - **65 (27%)**
- I don't know - **66 (28%)**

Online supplements are not copyedited prior to posting and the author(s) take full responsibility for the accuracy of all data.

Question 12

If you obtained a test looking for lung cancer and lung cancer was found, would you continue smoking?

- Yes - **24 (10%)**
- No - **130 (54%)**
- I don't know - **86 (36%)**

Question 13

If you obtained a test looking for lung cancer and an abnormality of the lung was found that was not cancer, would you continue smoking?

- Yes - **35 (15%)**
- No - **127 (53%)**
- I don't know - **78 (33%)**

Question 14

If your doctor or healthcare provider recommended it, would you get a CT scan to look for early lung cancer?

- Yes - **165 (69%)**
- No - **6 (2.5%)**
- I would want more information before deciding - **69 (29%)**

If answer is "yes" to Question 14

Question 14a

Why would you get the CT scan? Check all that apply.

- My doctor/healthcare provider recommended it - **130 (33%)**
- I am worried I might have lung cancer - **50 (13%)**
- If I have lung cancer, finding it early will make it easier to treat - **132 (33%)**
- I believe CT scans are a safe way to look for lung cancer - **78 (20%)**
- Other: _____ - **3 (0.8%)**

If answer is "no" to Question 14

Question 14b

Why would you not get the CT scan? Check all that apply.

- I don't think I am at risk for lung cancer - **2 (20%)**
- I don't want to know whether or not I have lung cancer - **3 (30%)**
- I am worried about the cost of the scan - **2 (20%)**
- I am worried the scan will find something else wrong with me - **1 (10%)**
- I am worried about radiation from the scan - **0 (0%)**
- Other: _____ - **2 (20%)**
 - "I don't believe in witch hunts, knock on enough doors, one will open."
 - "I would not accept treatment if I did have lung cancer."

Question 15

If you wanted more information about a scan that finds lung cancer early, how would you want to receive this information? Rank the following from most to least useful (1 = most useful; 7 = least useful):

- Through social media (e.g. Facebook, Twitter, Instagram) - **Mean rank: 6**
- Talking to your primary doctor - **Mean rank: 1.5**
- Receiving a phone call - **Mean rank: 4.5**
- Receiving a message through your electronic health record - **Mean rank: 3.3**
- Receiving a notification in the mail - **Mean rank: 4.1**
- Watching a local news segment or television special about this - **Mean rank: 4.3**
- Reading about this in a magazine/newspaper you subscribe to - **Mean rank: 4.7**
- Other (optional): _____

Question 16

Imagine you visit your doctor/healthcare provider for a regular checkup. They ask you to schedule a test as part of this checkup. What part of the test would matter most to you? Rank the following from most to least important (1 = most important; 5 = least important), if you believe multiple factors are equally important, assign them the same rank:

- Convenience of completing the test - **Mean rank: 4**
- The out-of-pocket cost of the test - **Mean rank: 3**
- A high chance the test will save my life - **Mean rank: 2.3**
- The accuracy of the test - **Mean rank: 2.3**
- The risk of harms associated with the test - **Mean rank: 3.5**
- Other: _____

Question 17

Where do you get your health/medical information from? Check all that apply.

- My primary doctor/healthcare provider - **218 (36%)**
- The internet - **175 (29%)**
- Television - **65 (11%)**
- Radio - **11 (1.8%)**
- Friends/family - **82 (13%)**
- Health magazine or newsletter - **51 (8.3%)**
- None of the above - **2 (0.3%)**
- Other: _____ - **10 (1.6%)**

The following questions (18-22) will focus on other parts of your health besides your lungs

Question 18

Sigmoidoscopy, colonoscopy and fecal occult blood testing are all exams to look for signs of cancer or other health problems in the colon. Have you ever had any of these exams?

- Yes - **141 (59%)**
- No - **99 (41%)**
- I don't know - **0 (0%)**

If answer is "yes" to Question 18

Question 18a

What was the main reason you decided to get a colon cancer test? Check all that apply.

- My doctor/healthcare provider recommended it - **137 (69%)**
- A relative/friend recommended it - **8 (4.0%)**
- I heard about the test on television - **3 (1.5%)**
- I read about the test in a newsletter/magazine - **7 (3.5%)**
- I was worried I might have colon cancer - **12 (6.1%)**
- It was easy to schedule the test - **21 (11%)**
- Other: _____ - **10 (5.1%)**

Question 19

What is your sex?

- Male - **67 (28%)**
- Female - **172 (72%)**
- Prefer not to answer - **1 (0.4%)**

Question 20

Do you identify your gender as being the same as your sex?

- Yes - **240 (100%)**
- No, please specify: _____ - **0 (0%)**

Question 20a (shown to female respondents only)

A mammogram is an x-ray of each breast to look for breast cancer. Have you ever had a mammogram?

- Yes - **138 (80%)**
- No - **33 (19%)**
- I don't know - **1 (0.6%)**

If answer is "yes" to Question 20a

Question 20b

What was the main reason you decided to get a mammogram? Check all that apply.

- My doctor/healthcare provider recommended it - **128 (63%)**
- A relative/friend recommended it - **8 (4%)**
- I heard about the test on television - **2 (1%)**
- I read about the test in a newsletter/magazine - **4 (2%)**
- I was worried I might have breast cancer - **19 (8.4%)**
- It was easy to schedule the mammogram - **24 (12%)**
- Other: _____ - **17 (8.4%)**

Question 21

When did you last receive an influenza (flu) vaccine?

- Within the past year - **90 (38%)**
- With the past 1 to 2 years - **19 (7.9%)**
- Within the past 2 to 5 years - **16 (6.7%)**
- More than 5 years ago - **45 (19%)**
- Not sure - **12 (5%)**
- Never - **58 (24%)**

Question 22

Suppose it is time for the yearly flu shot. Which of the following is most likely to lead to you getting the flu shot? Rank the following from most to least likely (1 = most useful; 4 = least useful):

- Your doctor/healthcare provider scheduling an appointment for you - **Mean rank: 1.8**
- Receiving a reminder email or electronic health record message to schedule an appointment - **Mean rank: 2.7**
- A reminder from your pharmacist when you pick up your prescriptions - **Mean rank: 2.9**
- A family member or friend recommending it - **Mean rank: 3**
- Other: _____

The following are general questions about you

Question 23

What is your height in feet and inches?

- Feet: _____ - **Mean height: 66 inches**
- Inches: _____

Question 24

How much do you weigh in lbs?

- Weight: _____ - **Mean weight: 172 lbs**

Question 25

Are you of Hispanic, Latino, or Spanish origin?

- Yes - **4 (1.7%)**
- No - **236 (98%)**

Question 26

What is your race or origin? Please check all that apply

- American Indian or Alaska Native - **4 (1.6%)**
- Black or African American - **10 (4%)**
- Asian - **2 (0.8%)**
- Native Hawaiian or Other Pacific Islander - **0 (%)**
- White - **225 (91%)**
- Some other race: _____ - **6 (2.4%)**

Question 27

What is your current employment status?

- Employed, full time - **85 (35%)**
- Employed, part-time - **44 (18%)**
- Employed, but on sick leave or maternity leave - **0 (0%)**
- Unemployed, looking for work - **13 (5.4%)**
- Unemployed, NOT looking for work - **7 (2.9%)**
- Disabled, due to medical condition, permanently or temporarily - **20 (8.3%)**
- Disabled, for other reasons - **3 (1.3%)**
- Student - **1 (0.4%)**
- Retired - **53 (22%)**
- Other: _____ - **14 (5.8%)**
- Prefer not to answer - **0 (0%)**

Question 28

What is the highest education level that you have attained?

- Less than High School - **5 (2.1%)**
- High school graduate or GED - **37 (15%)**
- Some college, no degree - **80 (33%)**
- Occupational/technical/vocational program - **18 (7.5%)**
- Associate degree: academic program - **39 (16%)**
- Bachelor's degree - **44 (18%)**
- Master's degree (e.g., M.A., M.S., M.Eng., M.Ed., M.B.A.) - **11 (4.6%)**
- Professional school degree (e.g., M.D., D.D.S., D.V.M., J.D.) - **2 (0.8%)**
- Doctoral degree (e.g., Ph.D., Ed.D.) - **4 (1.7%)**
- Prefer not to answer - **0 (0%)**

Question 29

How many people are currently living in your household, including yourself?

- Number of people: _____ - **Mean: 2.2**
- Of these people, how many are children (individuals under 18 years of age)? _____ - **Mean: 0.2**
- Of these people, how many are adults? _____ - **Mean: 1.9**
- Of the adults, how many bring income into the household? _____ - **Mean: 1.7**

Question 30

Which of these categories best describes your total combined family income for the past 12 months?

- Less than \$5,000 - **7 (2.9%)**
- \$5,000 through \$11,999 - **12 (5.0%)**
- \$12,000 through \$15,999 - **15 (6.3%)**
- \$16,000 through \$24,999 - **33 (14%)**
- \$25,000 through \$34,999 - **37 (15%)**
- \$35,000 through \$49,999 - **38 (16%)**
- \$50,000 through \$74,999 - **52 (22%)**
- \$75,000 through \$99,999 - **26 (11%)**
- \$100,000 through \$149,999 - **13 (5.4%)**
- \$150,000 through \$199,999 - **2 (0.8%)**
- \$200,000 and greater - **0 (0%)**
- Prefer not to answer - **5 (2.1%)**

Question 31

What is the primary source of your health care coverage?

- A plan purchased through an employer or union (includes plan purchased through another person's employer) - **83 (35%)**
- A plan that you or another family member buys on your own (includes Affordable Care Act or Obamacare coverage) - **29 (12%)**
- Medicare - **55 (23%)**
- Medicaid or other state program - **26 (11%)**
- TRICARE (formally CHAMPUS), VA, or Military - **15 (6.3%)**
- Alaska Native, Indian Health Service, Tribal Health Services - **0 (0%)**
- Some other source - **2 (0.8%)**
- None (no coverage) - **28 (12%)**
- Prefer not to answer - **2 (0.8%)**

e-Appendix 2: Short Questionnaire to Determine Respondents' Age and Smoking History

Question 1

How many cigarettes have you smoked in your entire life?

- None, I have never smoked cigarettes
- 1-99 cigarettes (less than 5 packs)
- 100 or more cigarettes (at least 5 packs)

Question 2

How old are you (in years)?

- Age: _____

Question 3

About how many total years have you smoked in your life?

- Total years smoking: _____

Question 4

On average, how many packs do/did you smoke in one day?

- Average packs a day: _____

Question 5

Have you quit smoking?

- Yes
- No

Question 5a (if "Yes" to Question 1)

How old were you when you quit?

- Age: _____

e-Table 1. Knowledge, Attitudes, and Beliefs

	MTurk Respondents Meeting USPSTF Criteria for High Risk Who Have Never Been Screened (n=216) % [95% CI]
Knowledge	
Responded "there is a test to screen for lung cancer"	39 [33-46]
Correctly identified LDCT as the lung cancer screening test*	33 [23-44]

Mechanical Turk (MTurk)

United States Preventive Services Task Force (USPSTF)

Confidence interval (CI)

Low-dose computed tomography (LDCT)

*Proportion calculated among individuals who responded there is a test to screen for lung cancer

e-Table 2. Multivariate Logistic Regression Model for Willingness to Screen

Variable	Adjusted OR (95% CI)
Age	0.94 (0.87-1.01)
Men	1.63 (0.77-3.48)
White Race	0.61 (0.19-1.93)
Former smoker	2.47 (1.20-5.08)
Commercial insurance	1.07 (0.43-2.66)
Other insurance	1.52 (0.56-4.12)
> High-school education	0.87 (0.37-2.03)
> Median national income	0.97 (0.51-1.87)
Family history of lung cancer	0.90 (0.43-1.88)
Chronic pulmonary disease	19.06 (2.45-148.54)
Reported knowledge of lung cancer screening	3.40 (1.70-6.79)
Belief that one is at high risk of lung cancer	1.66 (0.82-3.39)
Belief in the efficacy of lung cancer screening	5.05 (1.54-16.62)
Odds Ratio (OR) Confidence interval (CI)	

e-Table 3: MTurk Respondent Characteristics

	MTurk Respondents Meeting USPSTF Criteria for High Risk (n=240)	MTurk Respondents Meeting Only NCCN Category 2 Criteria for High Risk (n=54)
	n (% , IQR)	n (% , IQR)
Age		
Median	60 (7)	60 (13)
Women	173 (72%)	23 (43%)
Race		
White	219 (91%)	47 (87%)
American Indian/Alaska Native	4 (1.7%)	4 (7.4%)
Asian	2 (0.4%)	0 (0%)
Native Hawaiian/Pacific Islander	0 (0%)	0 (0%)
Black	9 (3.7%)	3 (5.6%)
Other	6 (2.5%)	0 (0%)
Hispanic	4 (1.7%)	1 (1.9%)
Highest education		
Less than high school	5 (2.1%)	1 (1.9%)
High school graduate/GED	37 (15%)	14 (26%)
Post-high school training, excluding college	57 (24%)	15 (28%)
Associate's degree or some college	80 (33%)	9 (17%)
Bachelor's degree	44 (18%)	12 (22%)
Graduate school	17 (7.0%)	3 (5.6%)
BMI		
Median	26 (7)	25 (9)
Current Smoker	148 (62%)	23 (57%)
Pack-years		
Median	42 (12)	40 (33)
Years Quit*		
Median	5 (8)	19 (23)
Prior malignancy (excluding lung cancer, BCC or SCC)	7 (2.9%)	9 (17%)



Chronic pulmonary disease		
Chronic bronchitis/emphysema	41 (17%)	22 (41%)
Pulmonary fibrosis	1 (0.4%)	2 (3.7%)
Exposures		
Silica	7 (2.9%)	0 (0%)
Asbestos	41 (17%)	10 (19%)
Family history of lung cancer	60 (25%)	24 (44%)
Insurance		
Employer-based commercial	83 (35%)	11 (20%)
Non-employer-based commercial	29 (12%)	2 (3.7%)
Medicare	55 (2%)	20 (37%)
Medicaid/other state program	26 (11%)	10 (19%)
TRICARE/VA/Military	13 (6.3%)	3 (5.6%)
Alaska Native/Indian/Tribal Health Services	0 (0%)	0 (0%)
Other	2 (0.8%)	2 (3.7%)
None	28 (12%)	6 (11%)
Income (%)		
<\$25,000	67 (28%)	14 (26%)
\$25,000-\$49,999	75 (3%)	24 (44%)
\$50,000-\$74,999	52 (22%)	8 (15%)
\$75,000-\$99,999	26 (11%)	4 (7.4%)
\$100,000-\$149,999	13 (5.4%)	3 (5.6%)
\$150,000-\$199,999	2 (0.8%)	1 (1.9%)
≥\$200,000	0 (0%)	0 (0%)
Decline to answer	5 (2.1%)	0 (0%)
*Calculated among former smokers (n=92) Mechanical Turk (MTurk) United States Preventive Services Task Force (USPSTF) National Comprehensive Cancer Network NCCN) Interquartile range (IQR) Body-mass index (BMI) General Education Development (GED) Basal cell carcinoma (BCC) Squamous cell carcinoma (SCC) Veterans' Affairs (VA)		

e-Table 4: Knowledge, Attitudes, and Beliefs

	MTurk Respondents Meeting USPSTF Criteria for High Risk (n=240) % [95% CI]	Respondents Meeting Only NCCN Category 2 Criteria for High Risk (n=54) % [95% CI]
Knowledge		
Responded "there is a test to screen for lung cancer"	44 [38-51]	41 [28-55]
Correctly identified LDCT as the lung cancer screening test*	35 [26-45]	36 [17-59]
Attitudes		
Willing to undergo lung cancer screening	69 [63-75]	72 [58-84]
Beliefs		
Believe that early-detection of cancer saves lives	89 [85-93]	96 [87-100]
Believe that early-detection of lung cancer saves lives	93 [89-96]	98 [90-100]
Believe they are at high-risk for lung cancer	69 [62-74]	56 [41-69]

Mechanical Turk (MTurk)

United States Preventive Services Task Force (USPSTF)

National Comprehensive Cancer Network (NCCN)

Confidence interval (CI)

Low-dose computed tomography (LDCT)

*Proportion calculated among individuals who responded there is a test to screen for lung cancer

e-Table 5. Knowledge, Attitudes, and Beliefs Among Eligible and Ineligible Respondents

	MTurk Respondents Meeting USPSTF Criteria for High Risk (n=240) % [95% CI]	MTurk Respondents Not Meeting USPSTF or NCCN Category 2 Criteria for High Risk (n=274) % [95% CI]
Knowledge		
Responded "there is a test to screen for lung cancer"	44 [38-51]	41 [35-47]
Correctly identified LDCT as the lung cancer screening test*	35 [26-45]	30 [21-39]
Attitudes		
Willing to undergo lung cancer screening	69 [63-75]	64 [58-70]
Beliefs		
Believe that early-detection of cancer saves lives	89 [85-93]	91 [87-94]
Believe that early-detection of lung cancer saves lives	93 [89-96]	91 [87-94]
Believe they are at high-risk for lung cancer	68 [62-74]	48 [42-54]

Mechanical Turk (MTurk)

United States Preventive Services Task Force (USPSTF)

National Comprehensive Cancer Network (NCCN)

Confidence interval (CI)

Low-dose computed tomography (LDCT)

*Proportion calculated among individuals who responded there is a test to screen for lung cancer

e-Table 6. Preferred Method of Learning about Lung Cancer Screening Among Respondents Meeting USPSTF Criteria for High Risk

Learning Method	Mean Rank*	SD
Primary healthcare provider	1.5	1.3
Electronic health record message	3.3	1.5
Notification in the mail	4.1	1.3
Local news segment or television special	4.3	1.5
Phone call	4.5	1.8
Magazine/newspaper article	4.7	1.7
Social media (e.g. Facebook, Twitter, Instagram)	6.0	1.6

United States Preventive Services Task Force (USPSTF)
Standard deviation (SD)

*1 = most preferred, 7 = least preferred