Lung nodules:
Those you were not looking for (incidental nodules) and those you were (lung cancer screening)

Family Medicine Education Lecture

12/6/23

Nodules you were not looking for: Incidental nodules

1.6 million incidental nodules found on CT scans every year

Pulmonary nodules on nearly half of all chest CT scans

- Benign
  - Granuloma (fungal, mycobacterial)
  - Hamartoma, fibroma
  - AVM
- Inflammatory
  - RA, amyloid, sarcoid, GPA
- Infectious
  - Fungal infection, pneumonia
- Malignant
  - Lung cancer
  - Metastatic cancer

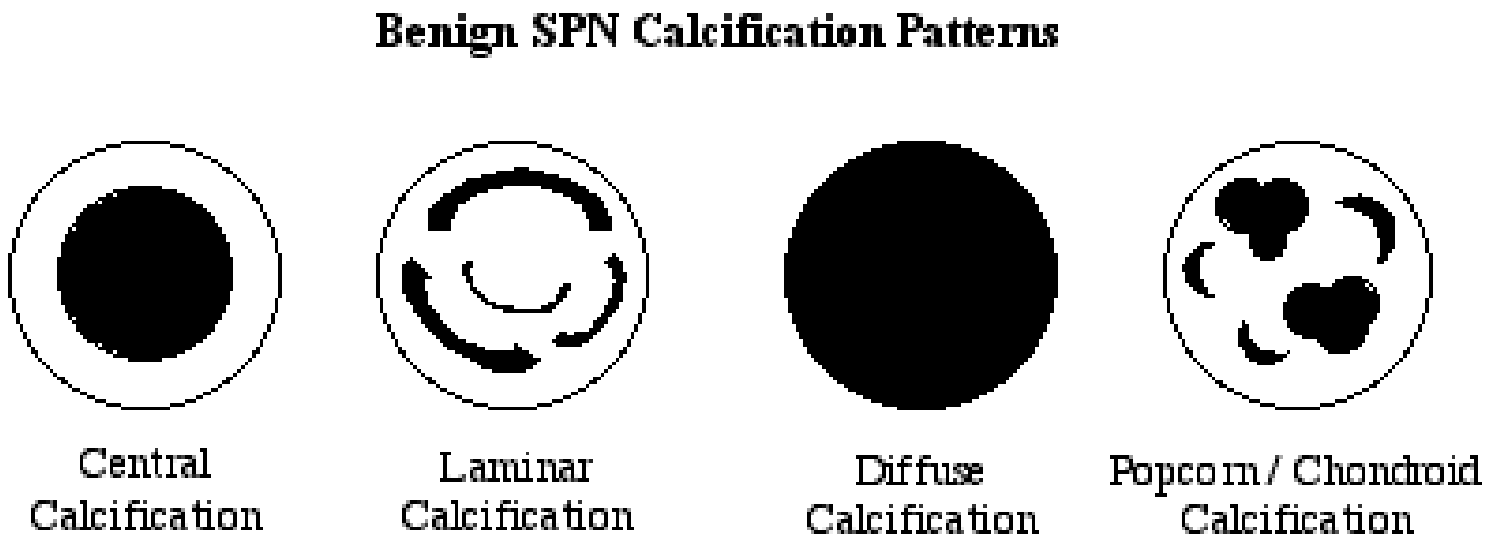
Nodule definition

- Rounded opacity
- Well marginated
- $\leq$ 3 cm in diameter
- Surrounded by lung parenchyma or visceral pleura

Traditional Evaluation of pulmonary nodule on radiograph

- Calcifications (*eccentric, stippled,* central, diffuse, popcorn)
- Margins (*spiculated, lobulated*, smooth)
- Location (*upper lobe*, perifissural)
- Size (*larger*)
- *Growth* (get previous imaging)

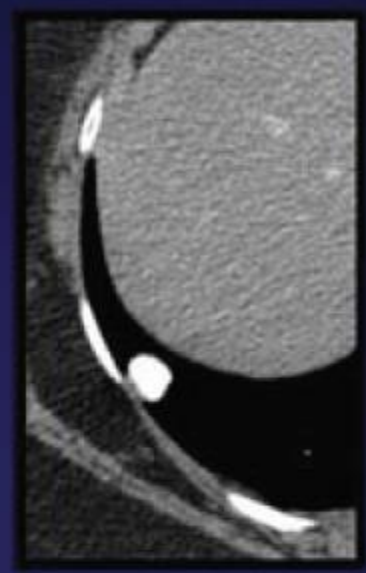
Patterns of calcification



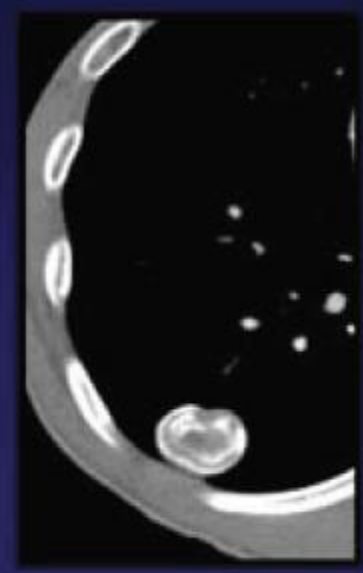
Nodule Characterization: Attenuation
Benign Pattern of Calcification

Central

Diffuse

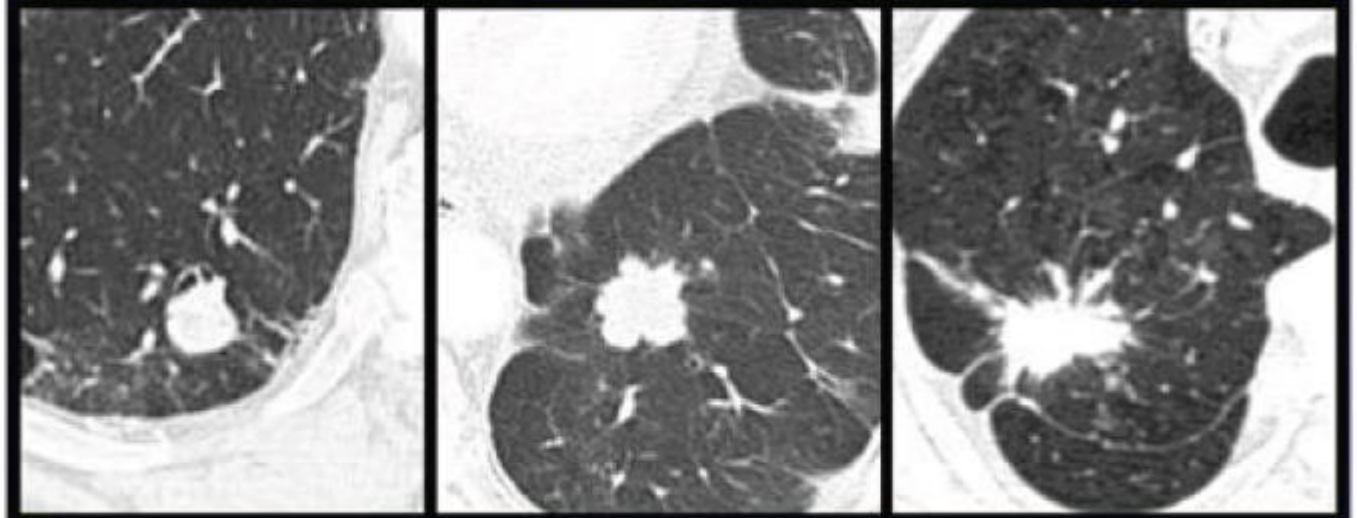


Laminated



Nodule Characterization: Margin

Smooth Lobulated Spiculated



Nodule Characterization

- Nodule Size and likelihood of malignancy:
  - 50% for nodules > 20 mm
  - 18% for those 8-20 mm in diameter
  - 0.9% for nodules 4-7 mm
  - 0.2% for those less that 3 mm

Midthun et al. Lung Cancer. Aug 2003;41 (suppl 2):S40

ERA of CT scans: Important to Differentiate between nodule attenuation

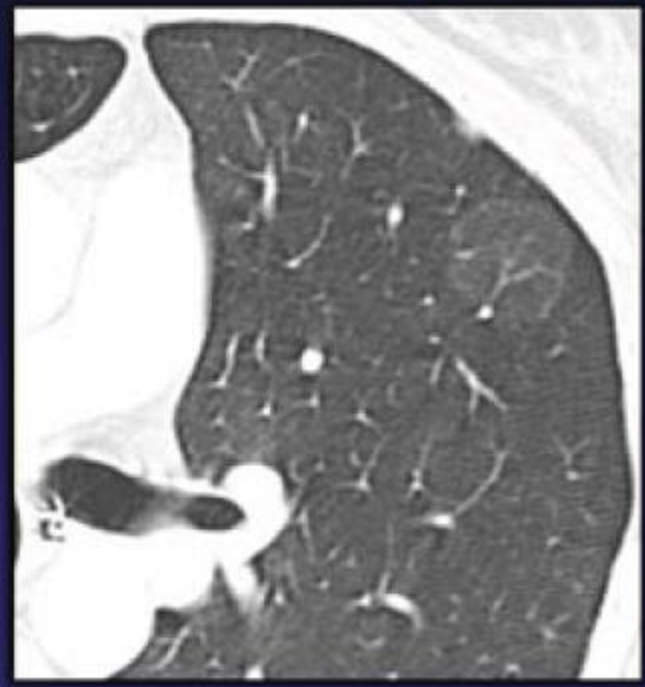
Solid nodules

- **Subsolid nodules***
  - Pure ground glass >10 mm (10-50% > are malignant)
  - Mixed ground glass with solid components (>50% are malignant)

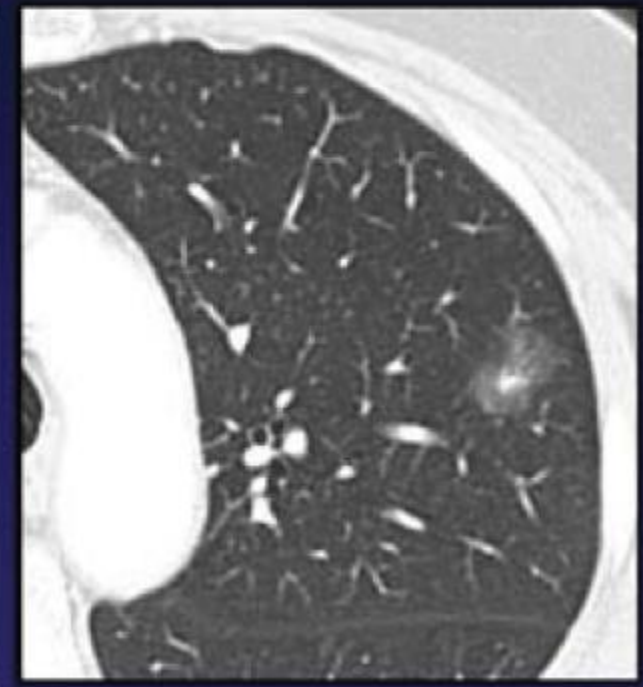
- *that persist

Nodule Attenuation: Subsolid Nodules

Non Solid (GGN)



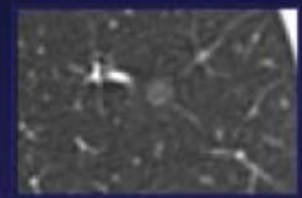
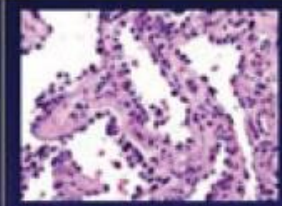
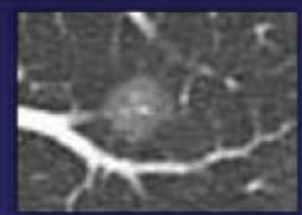
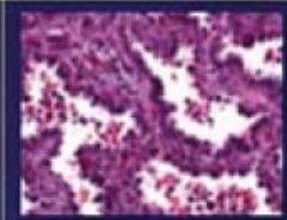
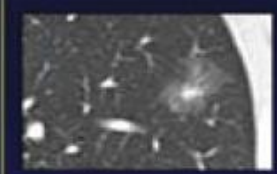
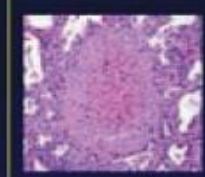
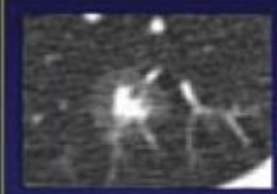
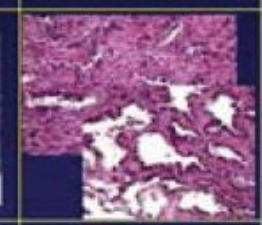
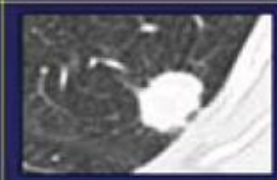
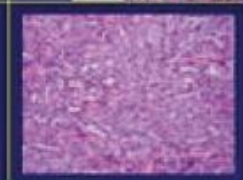
Part-Solid Nodules



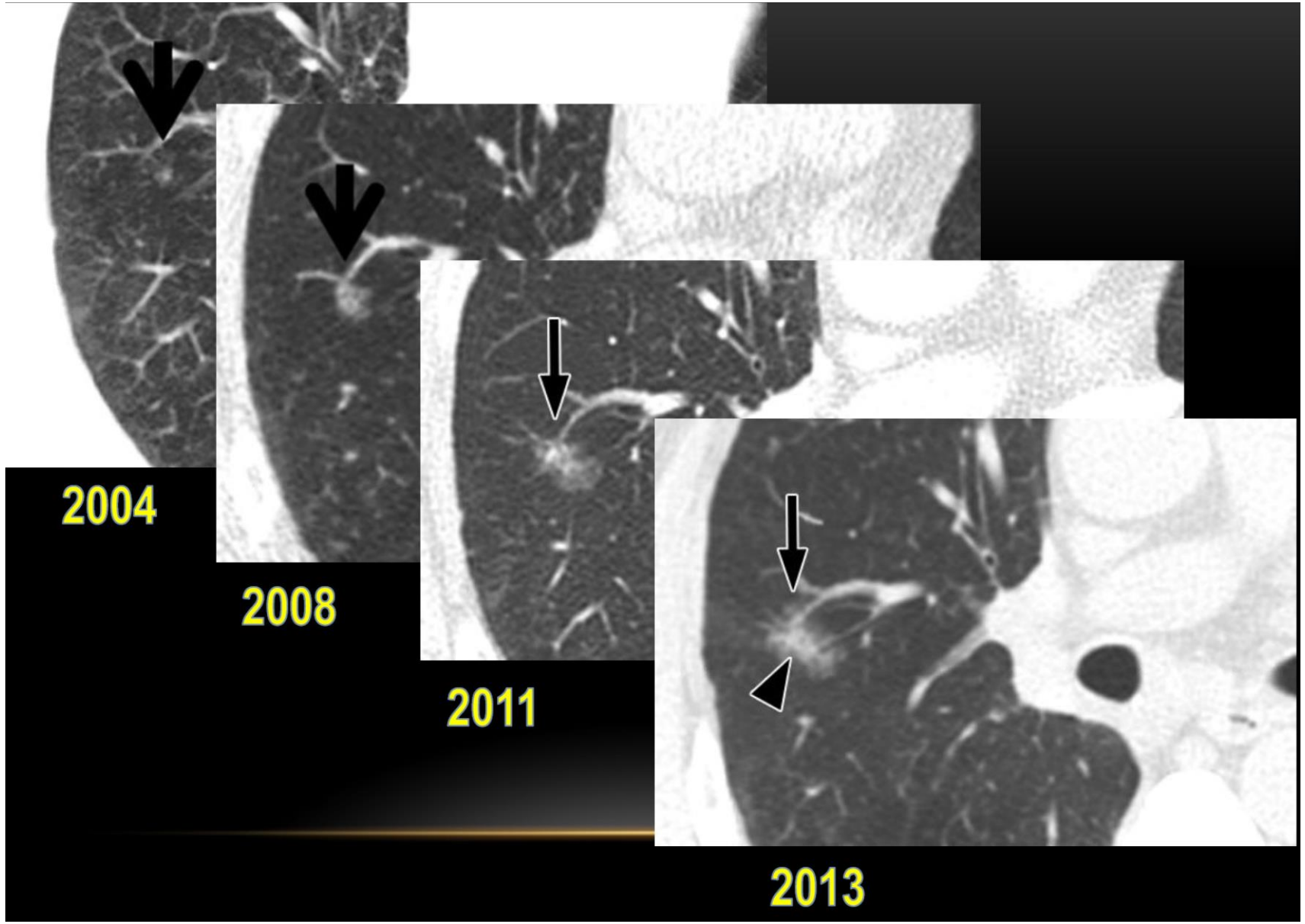
CT-Path Correlations

IASLC/ATS/ERS 2011*

Preinvasive Lesions

Atypical Adenomatous Hyperplasia (AAH)		
Adenocarcinoma *in situ*		
Minimally Invasive Adenocarcinoma		
Lepidic Predominant Adenocarcinoma		
Other invasive carcinomas		

*Travis WD et al. J Thorac Oncol. 2011;6:244-85


2004
2008
2011
2013

Cancer Med. 2023 Mar; 12(5): 5545–5557

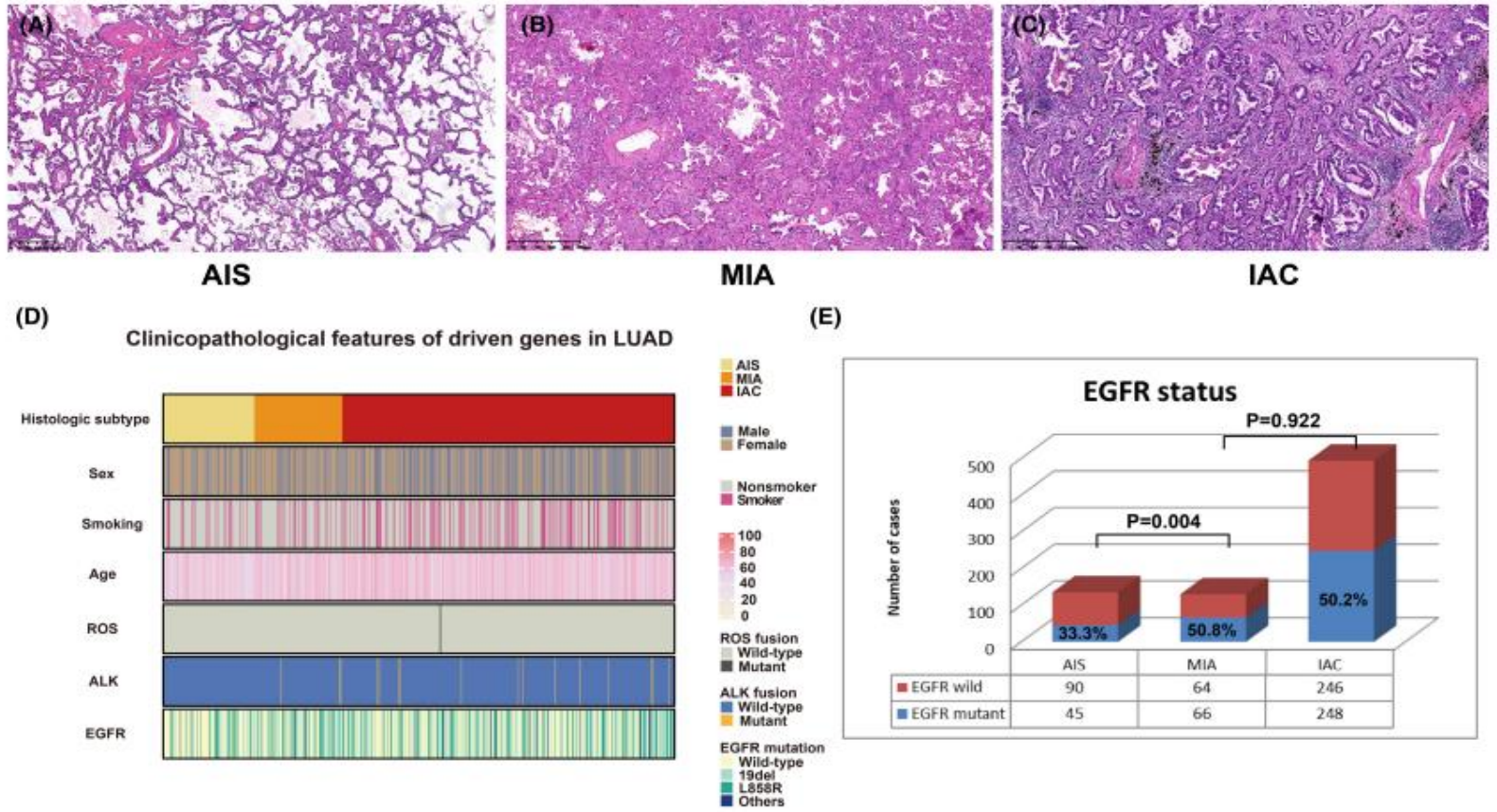


FIGURE 1 Clinicopathological characteristics and driver gene mutation status of the enrolled patients. (A–C) Typical pathological features of AIS, MIA and IAC. (D) Distribution of clinicopathological features and driver gene status among 759 patients. (E) EGFR mutation frequency in three stages of AIS-MIA-IAC.

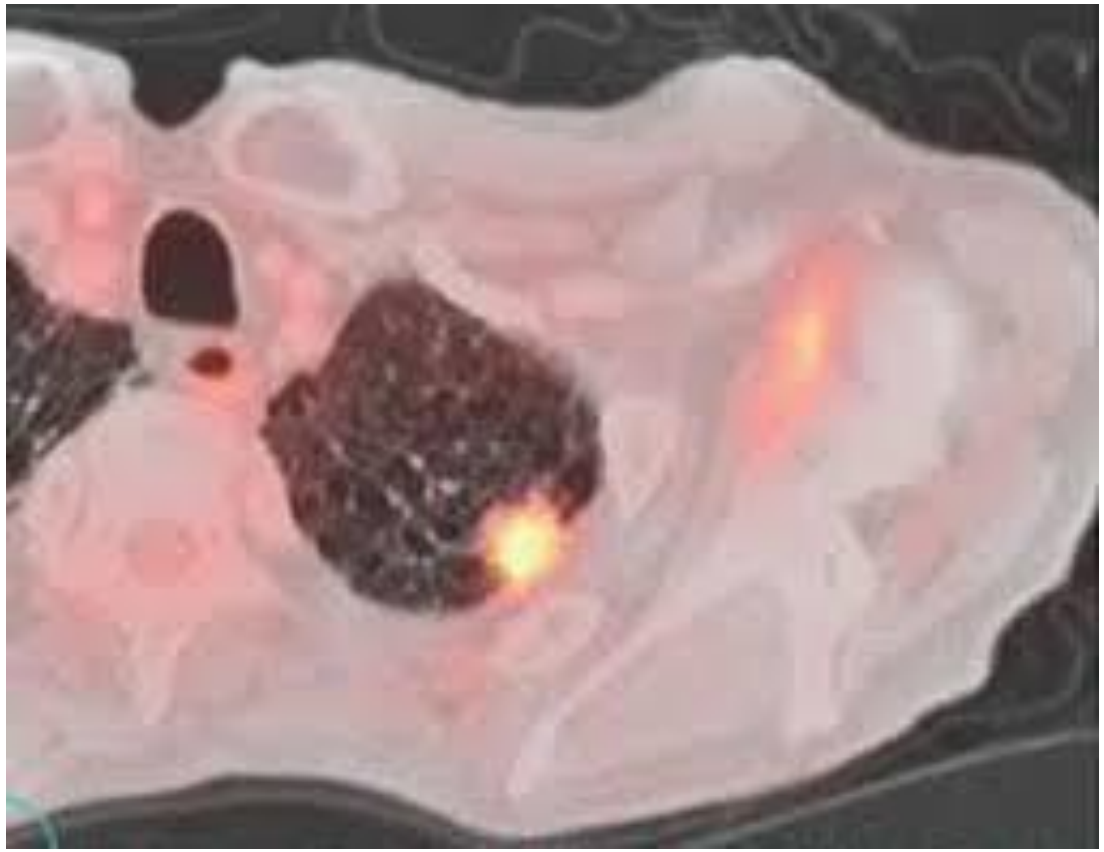
Important characteristic: Growth

- Solid: if stable for 2 years likely benign
  - Exceptions: carcinoid- indolent growth
- Subsolid/ground glass: are much slower growing
  - Follow out for 5 years or longer , endpoint is not determined

PET CT for malignancy

- Limited detection in:
  - Nodules < 8 mm
  - Pure GGNs
  - Carcinoid

- False positive with infectious, inflammatory causes



Evaluation of pulmonary nodule: high risk versus low risk patient

- Lung cancer risk factors:
  - Tobacco use
  - FH of lung cancer in first degree relative
  - Presence of emphysema or pulmonary fibrosis
  - Older age
  - personal history of cancer (previous lung cancer, lymphomas, head and neck CA)
  - Radiation to chest
  - Upper lobe location of nodule
  - radon exposure
  - occupational exposures (arsenic, chromium, asbestos, nickel, cadmium, beryllium, silica, diesel fumes)

Combine the radiographic and clinical characteristics and estimate probability of malignancy

Low probability ~ < 5 %

Intermediate probability ~5-65%

High probability > 65%

Risk calculators

- Probability of malignancy = e x (1+e x)
- x = −6.8272 + (0.0391 × age) + (0.7917 × smoke) + (1.3388 × cancer) + (0.1274 × diameter) + (1.0407 × spiculation) + (0.7838 × location) (Equation 2)
- where e is the base of natural logarithms, age is the patient's age in years, smoke = 1 if the patient is a current or former smoker (otherwise = 0), cancer = 1 if the patient has a history of an extrathoracic cancer that was diagnosed > 5 years ago (otherwise = 0), diameter is the diameter of the nodule in millimeters, spiculation = 1 if the edge of the nodule has spicules (otherwise = 0), and location = 1 if the nodule is located in an upper lobe (otherwise = 0). (Mayo Clinic)

- Brocku.ca/cancerpredictionresearch

- Of note, the accuracy of models for predicting malignancy appears to be similar to that of expert clinicians

Fleischner society guidelines 2017

Fleischner Society 2017 Guidelines for Management of Incidentally Detected Pulmonary Nodules in Adults

A: Solid Nodules*

	Size			
Nodule Type	<6 mm (<100 mm³)	6–8 mm (100–250 mm³)	>8 mm (>250 mm³)	Comments
Single				
Low risk†	No routine follow-up	CT at 6–12 months, then consider CT at 18–24 months	Consider CT at 3 months, PET/CT, or tissue sampling	Nodules <6 mm do not require routine follow-up, but certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-month follow-up (recommendation 1A).
High risk†	Optional CT at 12 months	CT at 6–12 months, then CT at 18–24 months	Consider CT at 3 months, PET/CT, or tissue sampling	Nodules <6 mm do not require routine follow-up, but certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-month follow-up (recommendation 1A).
Multiple				
Low risk†	No routine follow-up	CT at 3–6 months, then consider CT at 18–24 months	CT at 3–6 months, then consider CT at 18–24 months	Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk (recommendation 2A).
High risk†	Optional CT at 12 months	CT at 3–6 months, then at 18–24 months	CT at 3–6 months, then at 18–24 months	Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk (recommendation 2A).

B: Subsolid Nodules*

	Size		
Nodule Type	<6 mm (<100 mm³)	≥6 mm (>100 mm³)	Comments
Single			
Ground glass	No routine follow-up	CT at 6–12 months to confirm persistence, then CT every 2 years until 5 years	In certain suspicious nodules < 6 mm, consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection. (Recommendations 3A and 4A).
Part solid	No routine follow-up	CT at 3–6 months to confirm persistence. If unchanged and solid component remains <6 mm, annual CT should be performed for 5 years.	In practice, part-solid nodules cannot be defined as such until ≥6 mm, and nodules <6 mm do not usually require follow-up. Persistent part-solid nodules with solid components ≥6 mm should be considered highly suspicious (recommendations 4A-4C)
Multiple	CT at 3–6 months. If stable, consider CT at 2 and 4 years.	CT at 3–6 months. Subsequent management based on the most suspicious nodule(s).	Multiple <6 mm pure ground-glass nodules are usually benign, but consider follow-up in selected patients at high risk at 2 and 4 years (recommendation 5A).

Note.—These recommendations do not apply to lung cancer screening, patients with immunosuppression, or patients with known primary cancer.

* Dimensions are average of long and short axes, rounded to the nearest millimeter.

† Consider all relevant risk factors (see Risk Factors).

Fleishner society guidelines for incidentally detected lung nodules

- Fleishner society guidelines do not apply to:
  - Patient with known CA
  - Immunosuppressed patients
  - Lung cancer screening, which has separate criteria
  - intra-fissural or subpleural nodules
  - Perifissural nodules unless suspicious characteristics (spiculated margins, displacement of pulmonary fissure, cancer history)

Balancing the scale: clinical probability of cancer and patient preference (desire for certainty, fearful of risks) and comorbidities and risks of biopsy/ surgery/ treatment

Watch: CT scan surveillance

Act: Biopsy/ resection/ treatment

Nodules you were not looking for: Incidental nodules

- Importance of size for solid nodule or solid component of PSN (6mm, 8 mm)
- Change over time
- Long follow up for sub solid nodules
- Fleischner guidelines
- When probability high enough: biopsy/treatment

Nodules you were not looking for: Incidental nodules

1.6 million incidental nodules found on CT scans every year

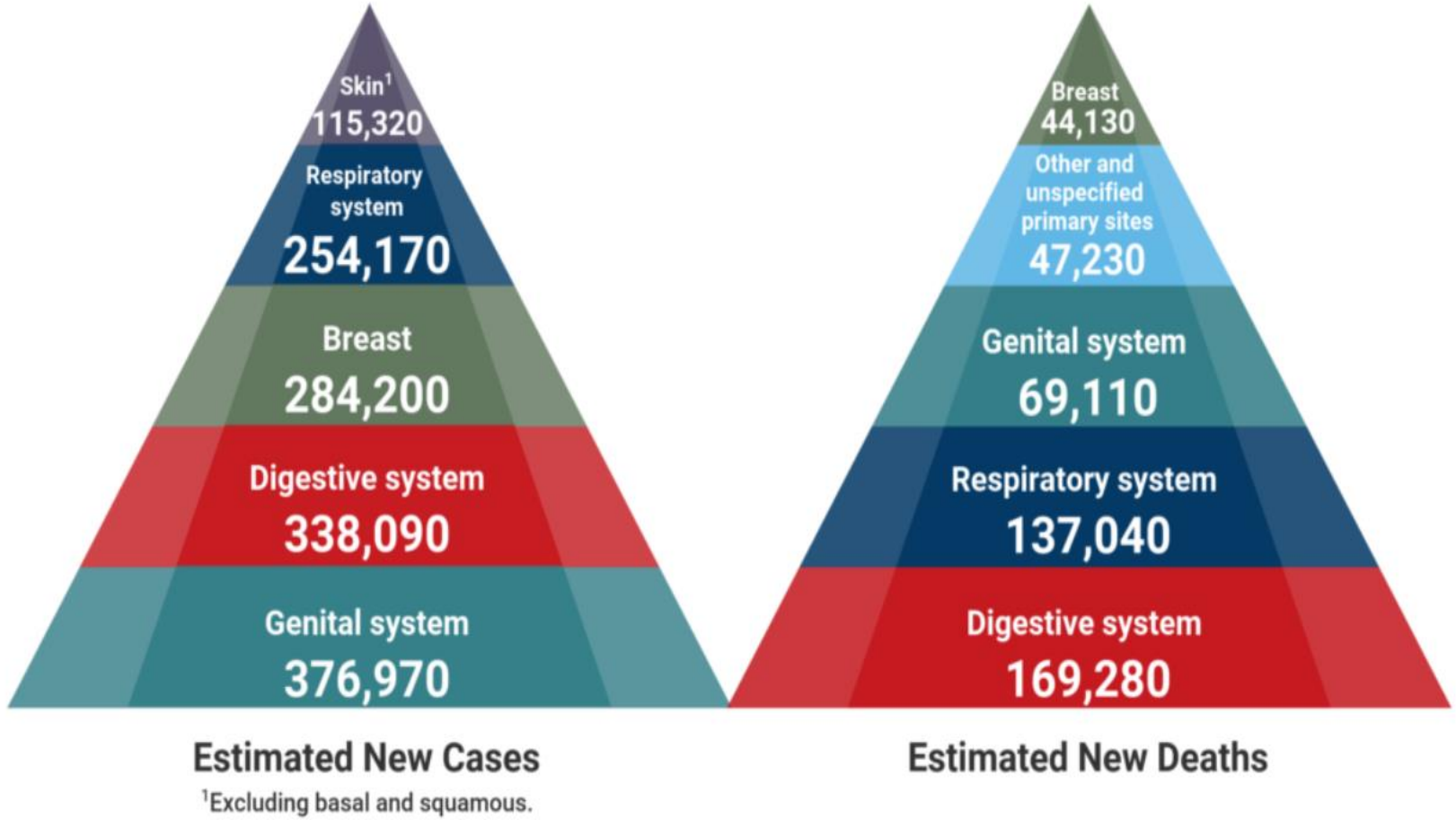
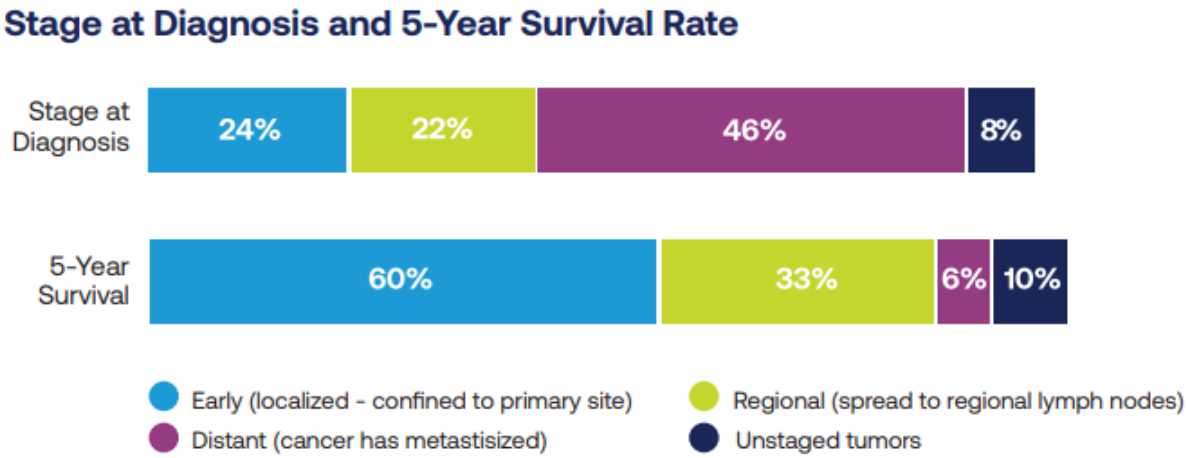
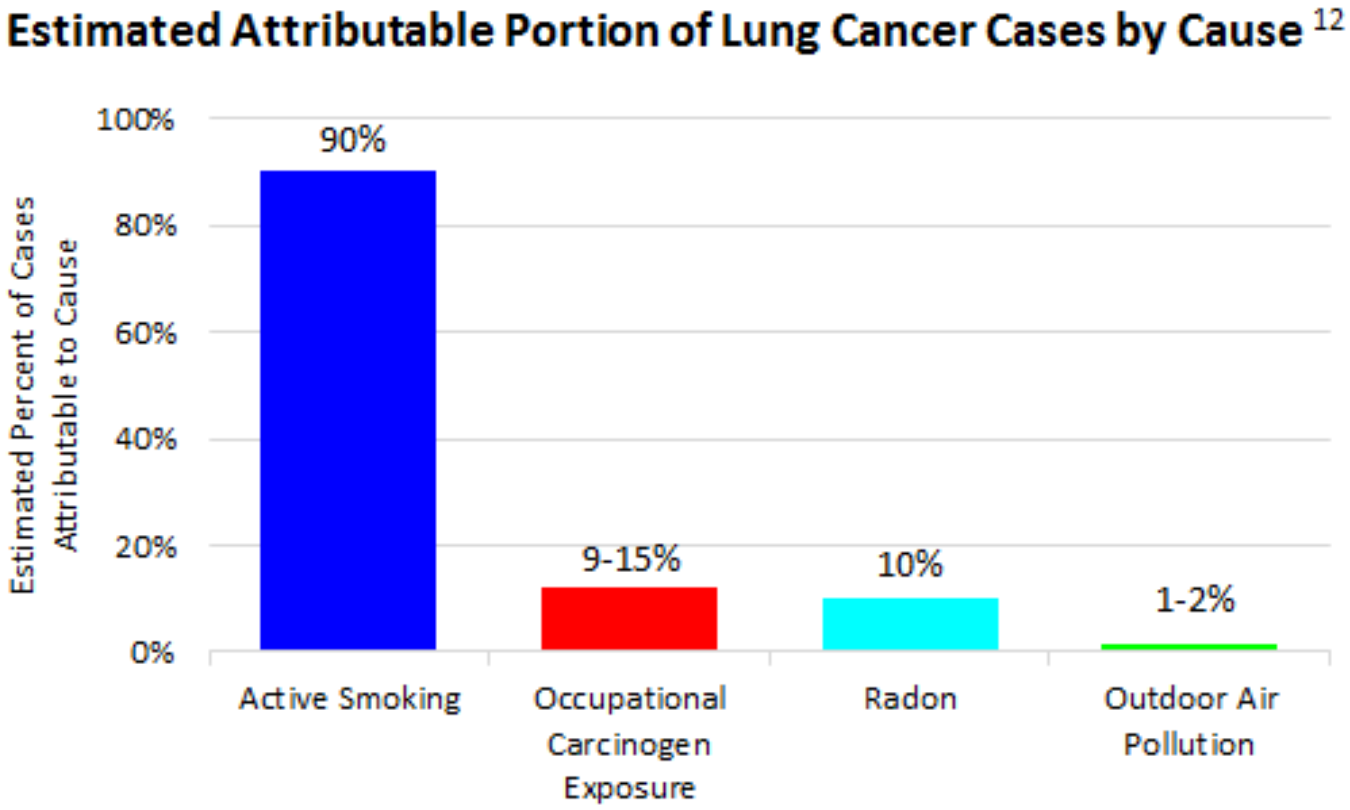


Figure 1. The five most common sites for estimated new cancer cases and deaths in the United States in 2021

The problem is we find it (too) late



Of course, in most cases the underlying problem



A brief message from our sponser…

Lung cancer screening: great idea, but historically was a bust

- 1970-1990 five randomized controlled trials of CXR, sputum cytology that showed no benefit
- 1993- 2004 PLCO trial- compared 70K patients (any smoking) with annual CXR x 3 years to 70K without annual CXR– no decrease in lung cancer deaths in 13 years follow up
- 2004 USPSTF found inadequate evidence to recommend for or against lung cancer screening

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 4, 2011 VOL. 365 NO. 5

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

The Study : NLST

- Participants
  - 53,454 asymptomatic high risk smokers
  - 30 academic centers
  - Age 55-74, 30 pack years, within 15 years from last cigarette
  - Would be willing and able to undergo lung resection surgery.
- Annual low dose CT (LDCT) scan for three years, versus annual CXR for three years
- Followed for 6.5 years
- Chances of dying from lung cancer:
  - 1.33 % if you took annual LDCT scans (356 lung cancer deaths/ 26,722 patients)
  - 1.66 % if you took annual CXR (443 lung cancer deaths/ 26,732 patients)
  - p = .004

Imagine Putting 50,000 heavy smokers in Dodger stadium for 6 years…

3 years of annual CXR side of stadium = 443 lung cancer deaths

3 years of annual LDCT side of stadium: 356 lung cancer deaths

NLST Results: Potential Benefit

- How do we present statistical information to the patient?
  - Number needed to treat (NNT) = 320.

    3 fewer deaths per 1000 screened
  - Absolute risk reduction = 1.66% vs 1.33 %
  - 20% relative risk reduction

NLST Results: Potential Harms

- False negative (80% of lung cancer still evades our screening)
- False positive (25% of the time we find something, 95 % of the time it’s nothing)
- Over diagnosis (find something, but it doesn’t matter)
- Radiation risks
- Anxiety
- (Financial costs)

Potential Harms: Radiation risks of LDCT

- “We don’t know, probably some, shows up in 10-20 years”.
- About 1/4 the dose of a regular CT chest and 1/8 the dose of a PET-CT
- LDCT delivers small dose radiation- primarily lung and breast (4 mGy). Mammogram delivers similar dose to breasts (4 mGy), but less to lungs, so total average dose to all body organs from mammogram is ½ less that that of LDCT
    - LDCT 0.61-1.5 mSv
    - Mammogram 0.7 mSv
    - CXR 0.05 mSv
    - Annual background radiation 2.4 mSv
- Estimated that one lung tumor is caused for for every 2500 screening CT’s

LUNG CANCER SCREENING- A NEW ERA

2013 USPTF RECOMMENDED SCREENING 55-80 YEAR OLDS, 30 PK YR SMOKERS, QUIT WITHIN 15 YEARS

ADDITIONAL TRIALS (EG: NELSON 15,000 PEOPLE, 15 PK YEAR SMOKERS, 4 ANNUAL SCANS, 10 YEAR FOLLOW UP. 24% RR REDUCTION. PUBLISHED YR 2019)

COMPUTER MODELING (CISNET)

	USPSTF Guidelines 2013-2021	USPSTF Guidelines 2021
Age	55-80 years	50-80 years
Smoking History	30 or more pack years (this means 1 pack a day for 30 years, 2 packs a day for 15 years, etc.)	20 or more pack years (this means 1 pack a day for 20 years, 2 packs a day for 10 years, etc.)
Smoking Status	Current smoker or quit within the last 15 years	

National Coverage Determination (NCD)

Lung Cancer Screening with Low Dose Computed Tomography (LDCT)

210.14

Effective for claims with dates of service on or after February 10, 2022, CMS has determined that the evidence is sufficient to cover, under Medicare Part B, a lung cancer screening counseling and shared decision-making visit, and for appropriate beneficiaries, annual screening for lung cancer with LDCT, as an additional preventive service benefit under the Medicare program, only if all of the following eligibility criteria are met.

Beneficiary Eligibility Criteria

Beneficiaries must meet all of the following eligibility criteria:

- Age 50 - 77 years;
- Asymptomatic (no signs or symptoms of lung cancer);
- Tobacco smoking history of at least 20 pack-years (one pack-year = smoking one pack per day for one year; 1 pack =20 cigarettes);
- Current smoker or one who has quit smoking within the last 15 years; and,
- Receive an order for lung cancer screening with LDCT.

Counseling and Shared Decision-Making Visit

Before the beneficiary's first lung cancer LDCT screening, the beneficiary must receive a counseling and shared decision-making visit that meets all of the following criteria, and is appropriately documented in the beneficiary's medical records:

- Determination of beneficiary eligibility;
- Shared decision-making, including the use of one or more decision aids;
- Counseling on the importance of adherence to annual lung cancer LDCT screening, impact of comorbidities and ability or willingness to undergo diagnosis and treatment; and,
- Counseling on the importance of maintaining cigarette smoking abstinence if former smoker; or the importance of smoking cessation if current smoker and, if appropriate, furnishing of information about tobacco cessation interventions.

Still, Not everyone is entirely convinced…

Concern that harms are underrecognized: possibility of over diagnosis, false positives leading to interventions, other harms

Indication "creep" to patients outside intended population

Screening not done as designed in trials –no structured interpretation and follow up

Barriers to care in some communities

To improve on benefit/harm ratio can we improve on risk assessment

- -Average age in NLST was 62 years old, 50 pack years of smoking, but there was quite a range of patient risk factors for lung cancer
- -Accounting for additional risk factors can help assess patient's individual risk.
- -Evaluating the NLST data with a "risk calculator"
    - NNT 161 in highest quintile of risk

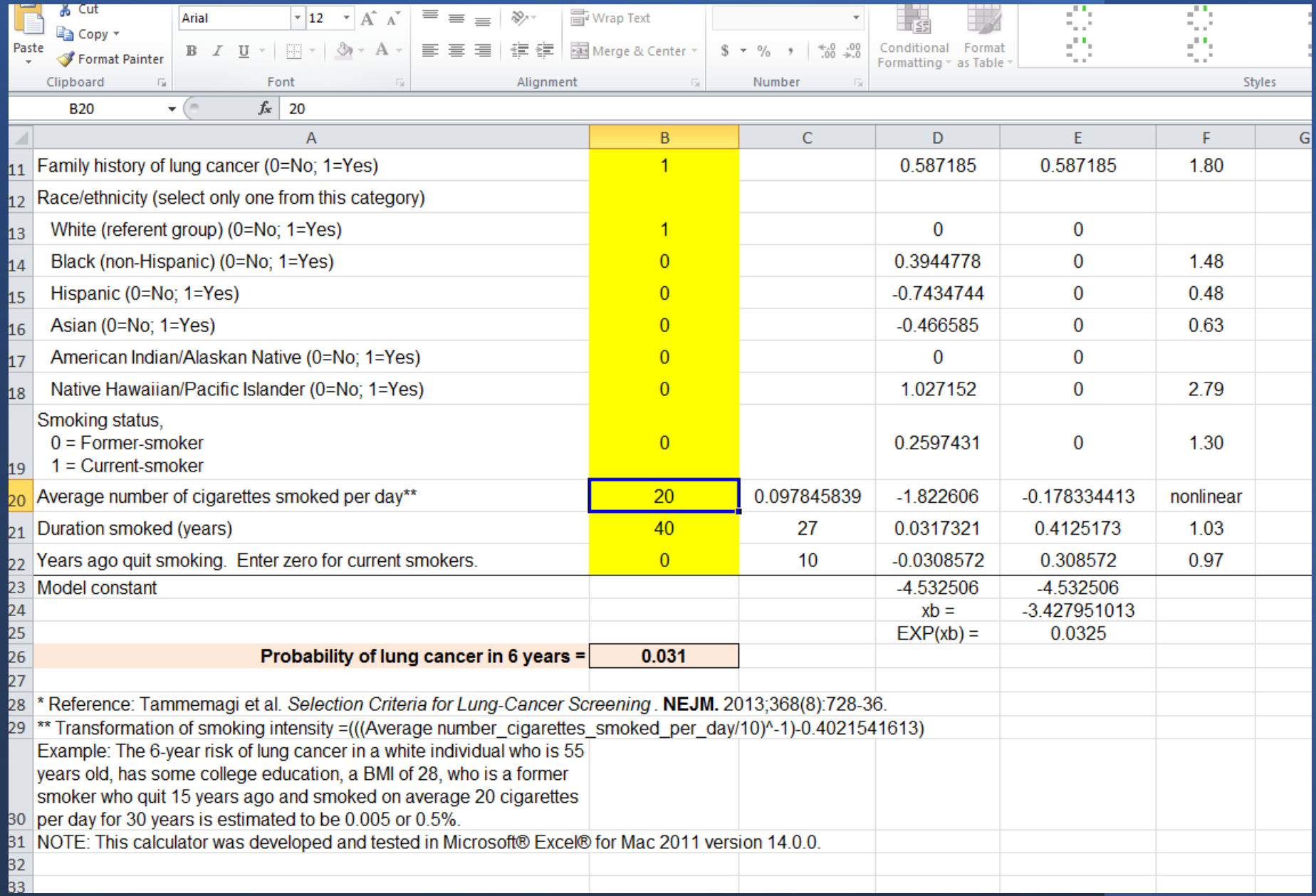
    NNT 5,276 in lowest quintile of risk

$PLCO_{m2012}$

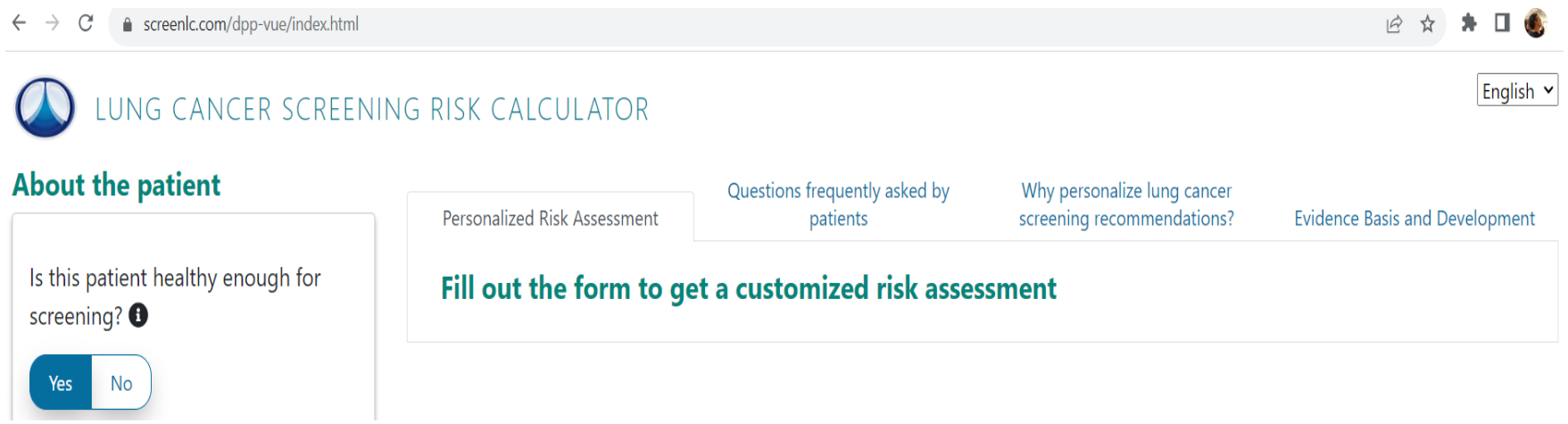
Predictors of Risk

- ↑ age
- Δ race/ethnicity
- ↓ education (SES)
- ↓ body mass index
- ↑ personal history of cancer
- ↑ family history of lung cancer
- ↑ COPD
- ↑ smoking status,
  - ↑*intensity*, ↑duration, ↓quit-time

PLCO: Prostate Lung Colorectal Ovarian Cancer Screening Trial



	A	B	C	D	E	F	G
11	Family history of lung cancer (0=No; 1=Yes)	1		0.587185	0.587185	1.80	
12	Race/ethnicity (select only one from this category)						
13	White (referent group) (0=No; 1=Yes)	1		0	0		
14	Black (non-Hispanic) (0=No; 1=Yes)	0		0.3944778	0	1.48	
15	Hispanic (0=No; 1=Yes)	0		-0.7434744	0	0.48	
16	Asian (0=No; 1=Yes)	0		-0.466585	0	0.63	
17	American Indian/Alaskan Native (0=No; 1=Yes)	0		0	0		
18	Native Hawaiian/Pacific Islander (0=No; 1=Yes)	0		1.027152	0	2.79	
19	Smoking status, 0 = Former-smoker 1 = Current-smoker	0		0.2597431	0	1.30	
20	Average number of cigarettes smoked per day**	20	0.097845839	-1.822606	-0.178334413	nonlinear	
21	Duration smoked (years)	40	27	0.0317321	0.4125173	1.03	
22	Years ago quit smoking. Enter zero for current smokers.	0	10	-0.0308572	0.308572	0.97	
23	Model constant			-4.532506	-4.532506		
24				xb =	-3.427951013		
25				EXP(xb) =	0.0325		
26	**Probability of lung cancer in 6 years =**	**0.031**					
27							
28	* Reference: Tammemagi et al. *Selection Criteria for Lung-Cancer Screening* . **NEJM.** 2013;368(8):728-36.						
29	** Transformation of smoking intensity =(((Average number_cigarettes_smoked_per_day/10)^-1)-0.4021541613)						
30	Example: The 6-year risk of lung cancer in a white individual who is 55 years old, has some college education, a BMI of 28, who is a former smoker who quit 15 years ago and smoked on average 20 cigarettes per day for 30 years is estimated to be 0.005 or 0.5%.						
31	NOTE: This calculator was developed and tested in Microsoft® Excel® for Mac 2011 version 14.0.0.						
32							
33							



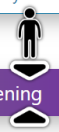
Screenlc.com

Screening benefits likely outweigh harms

- Risk of developing lung cancer in 5 years: **8.94%**
- Patients needed to screen to avoid 1 lung cancer death: **124 patients**
- Life expectancy without screening: **13.9 years**
- Due to very high lung cancer risk and reasonable life expectancy, screening benefits likely outweigh harms like **false positive findings** leading to invasive tests

Print this page for the patient

Why is my patient in this category?*



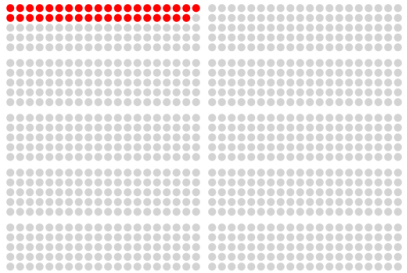
Discourage Screening | Preference Sensitive | Encourage Screening

Screening is likely high benefit for this patient

Among 1,000 people like this person...

Close this chart

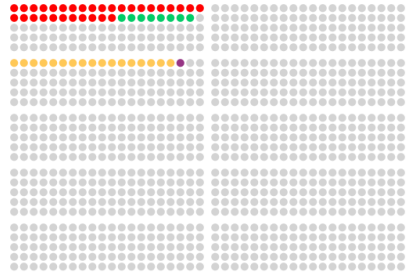
Not screened



Legend:

People who died from lung cancer within 5 years	39

Screened every year for 3 years



Legend:

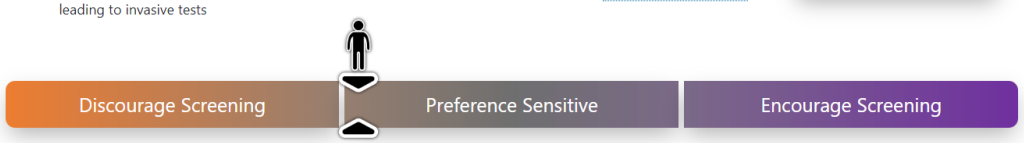
People who died from lung cancer within 5 years	31
People who avoided a lung cancer death due to screening	8
Many people need a repeat CT scan due to false-positive findings*	
People who had an invasive test following a false alarm**	17
People who had complications following invasive tests	1

Appropriateness of screening depends on patient preferences (Benefits ~ Harms)

- Risk of developing lung cancer in 5 years: **0.29%**
- Patients needed to screen to avoid 1 lung cancer death: **2892 patients**
- Life expectancy without screening: **29.1 years**
- Due to moderate lung cancer risk, screening benefits are in fine balance with harms like **false positive findings** leading to invasive tests

Print this page for the patient

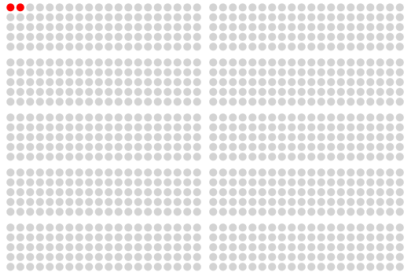
Why is my patient in this category?*



Among 1,000 people like this person...

Close this chart

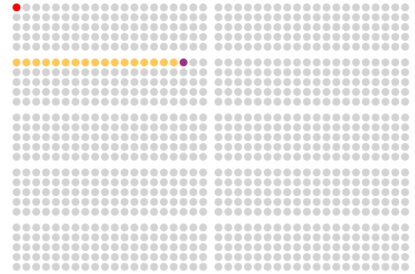
Not screened



Legend:

People who died from lung cancer within 5 years	2

Screened every year for 3 years

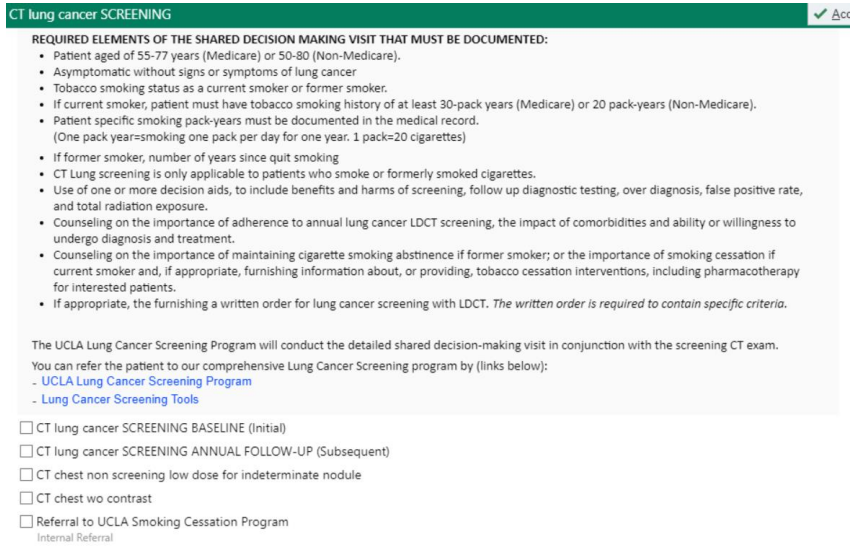


Legend:

People who died from lung cancer within 5 years	1
People who avoided a lung cancer death due to screening	<1
Many people need a repeat CT scan due to false-positive findings*	
People who had an invasive test following a false alarm**	17
People who had complications following invasive tests	1

Harms: Anxiety

https://www.uclahealth.org/cancer/cancer-services/lung-cancer/diagnosis-treatment/lung-cancer-screening



CT lung cancer SCREENING

REQUIRED ELEMENTS OF THE SHARED DECISION MAKING VISIT THAT MUST BE DOCUMENTED:

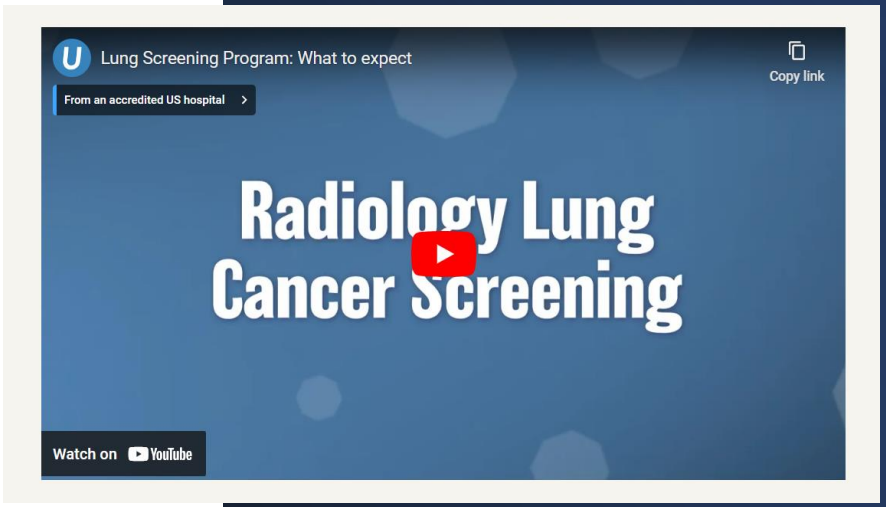
- Patient aged of 55-77 years (Medicare) or 50-80 (Non-Medicare).
- Asymptomatic without signs or symptoms of lung cancer
- Tobacco smoking status as a current smoker or former smoker.
- If current smoker, patient must have tobacco smoking history of at least 30-pack years (Medicare) or 20 pack-years (Non-Medicare).
- Patient specific smoking pack-years must be documented in the medical record.
  (One pack year=smoking one pack per day for one year. 1 pack=20 cigarettes)
- If former smoker, number of years since quit smoking
- CT Lung screening is only applicable to patients who smoke or formerly smoked cigarettes.
- Use of one or more decision aids, to include benefits and harms of screening, follow up diagnostic testing, over diagnosis, false positive rate, and total radiation exposure.
- Counseling on the importance of adherence to annual lung cancer LDCT screening, the impact of comorbidities and ability or willingness to undergo diagnosis and treatment.
- Counseling on the importance of maintaining cigarette smoking abstinence if former smoker; or the importance of smoking cessation if current smoker and, if appropriate, furnishing information about, or providing, tobacco cessation interventions, including pharmacotherapy for interested patients.
- If appropriate, the furnishing a written order for lung cancer screening with LDCT. *The written order is required to contain specific criteria.*

The UCLA Lung Cancer Screening Program will conduct the detailed shared decision-making visit in conjunction with the screening CT exam.

You can refer the patient to our comprehensive Lung Cancer Screening program by (links below):

- UCLA Lung Cancer Screening Program
- Lung Cancer Screening Tools

- ☐ CT lung cancer SCREENING BASELINE (Initial)
- ☐ CT lung cancer SCREENING ANNUAL FOLLOW-UP (Subsequent)
- ☐ CT chest non screening low dose for indeterminate nodule
- ☐ CT chest wo contrast
- ☐ Referral to UCLA Smoking Cessation Program
  Internal Referral



To Improve on interpretation = Structured report

ACR LungRADS® Released April 2014

- Modeled after the ACR's 20 year experience with BIRADS, now it's fifth edition
- Structured reporting and management tool for lung cancer screening CT interpretation
- Practice audit component

http://www.acr.org/Quality-Safety/Resources/LungRADS

ACR AMERICAN COLLEGE OF RADIOLOGY

Lung-RADS® 2022

Release Date: November 2022

Lung-RADS	Category Descriptor	Findings	Management
0	**Incomplete** Estimated Population Prevalence: [a] 1%	Prior chest CT examination being located for comparison (see note 9)	Comparison to prior chest CT;
		Part or all of lungs cannot be evaluated	Additional lung cancer screening CT imaging needed;
		Findings suggestive of an inflammatory or infectious process (see note 10)	1-3 month LDCT
1	**Negative** Estimated Population Prevalence: 39%	**No lung nodules OR**	12-month screening LDCT
		Nodule with benign features: • Complete, central, popcorn, or concentric ring calcifications **OR** • Fat-containing	
2	**Benign** Based on imaging features or indolent behavior Estimated Population Prevalence: 45%	**Juxtapleural nodule:** • < 10 mm (524 mm³) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	
		Solid nodule: • < 6 mm (< 113 mm³) at baseline **OR** • New < 4 mm (< 34 mm³)	
		Part-solid nodule: • < 6 mm total mean diameter (< 113 mm³) at baseline	
		Non-solid nodule (GGN): • < 30 mm (< 14,137 mm³) at baseline, new, or growing **OR** • ≥ 30 mm (≥ 14,137 mm³) stable or slow-growing (see note 7)	
		Airway nodule, subsegmental at baseline, new, or stable (see note 11)	
		Category 3 nodule that is stable or decreased in size at 6-month follow-up CT, **OR** Category 3 or 4A nodules that resolve on follow-up, **OR** Category 4B findings proven to be benign in etiology following appropriate diagnostic workup	
3	**Probably Benign** Based on imaging features or behavior Estimated Population Prevalence: 9%	**Solid nodule:** • ≥ 6 to < 8 mm (≥ 113 to < 268 mm³) at baseline **OR** • New 4 mm to < 6 mm (34 to < 113 mm³)	6-month LDCT
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm³) with solid component < 6 mm (< 113 mm³) at baseline **OR** • New < 6 mm total mean diameter (< 113 mm³)	
		Non-solid nodule (GGN): • ≥ 30 mm (≥ 14,137 mm³) at baseline or new	
		Atypical pulmonary cyst: (see note 12) • Growing cystic component (mean diameter) of a thick-walled cyst	
		Category 4A nodule that is stable or decreased in size at 3-month follow-up CT (excluding airway nodules)	
4A	**Suspicious** Estimated Population Prevalence: 4%	**Solid nodule:** • ≥ 8 to < 15 mm (≥ 268 to < 1,767 mm³) at baseline **OR** • Growing < 8 mm (< 268 mm³) **OR** • New 6 to < 8 mm (113 to < 268 mm³)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm³) solid nodule or solid component
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm³) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm³) at baseline **OR** • New or growing < 4 mm (< 34 mm³) solid component	
		Airway nodule, segmental or more proximal at baseline or new (see note 11)	
		Atypical pulmonary cyst: (see note 12) • Thick-walled cyst **OR** • Multilocular cyst at baseline **OR** • Thin- or thick-walled cyst that becomes multilocular	
4B	**Very Suspicious** Estimated Population Prevalence: 2%	**Airway nodule,** segmental or more proximal, and stable or growing (see note 11)	Referral for further clinical evaluation Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm³) solid nodule or solid component; tissue sampling; and/or referral for further clinical evaluation Management depends on clinical evaluation, patient preference, and the probability of malignancy (see note 13)
		Solid nodule: • ≥ 15 mm (≥ 1,767 mm³) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm³)	
		Part-solid nodule: • Solid component ≥ 8 mm (≥ 268 mm³) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm³) solid component	
		Atypical pulmonary cyst: (see note 12) • Thick-walled cyst with growing wall thickness/nodularity **OR** • Growing multilocular cyst (mean diameter) **OR** • Multilocular cyst with increased loculation or new/increased opacity (nodular, ground glass, or consolidation)	
		Slow-growing-solid or part-solid nodule that demonstrates growth over multiple screening exams (see note 8)	
4X	Estimated Population Prevalence: < 1%	Category 3 or 4 nodules with additional features or imaging findings that increase suspicion for lung cancer (see note 14)	
S	**Significant or Potentially Significant** Estimated Population Prevalence: 10%	**Modifier:** May add to category 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer (see note 15)	As appropriate to the specific finding

Improve on Follow up: Nodule conference, nodule clinic

"Screening should be conducted in a center similar to those where the NLST was conducted, with multidisciplinary coordinated care and a comprehensive process for screening, image interpretation, management of findings, and evaluation and treatment of potential cancers"

Systematic review JAMA 2012; 307 (22) 2418-2429

Low DOSE lung cancer screening in the primary care clinic

- **Ability and willingness to undergo treatment**
  - "Don't screen if life limiting conditions"
- **Asymptomatic**
  - Diagnostic CT for patients who have symptoms (cough, weight loss, SOB, chest pain, hoarseness, bone pain)
- **Provide counseling & Shared Decision Making**
  - **Provide balanced, understandable, consistent information**
  - Potential Benefits: NLST data
  - Potential Harms
    - False positives
    - Over diagnosis
    - False negatives
    - Radiation
    - Anxiety
    - (Financial cost)
  - Scientific uncertainties
  - Consider patient preferences for specific health outcomes
  - Deliberation often takes a lot longer than the implementation

Chest LDCT for lung cancer screening- caution

- Screening CT may have other incidental findings which will need proper followup:
  - Coronary artery calcifications
  - Thyroid, adrenal, liver, kidney nodules
  - Thoracic aneurysm
  - Pleural effusion
  - Parenchymal lung disease
  - Emphysema
- *Individuals with symptoms should undergo diagnostic chest CT rather than LDCT screening.*

Nodules you were looking for: lung cancer screening

- Smoking cessation
- Confirm eligibility and risk factors
- Counseling and shared decision making (risks and benefits discussion)
- Structured follow up