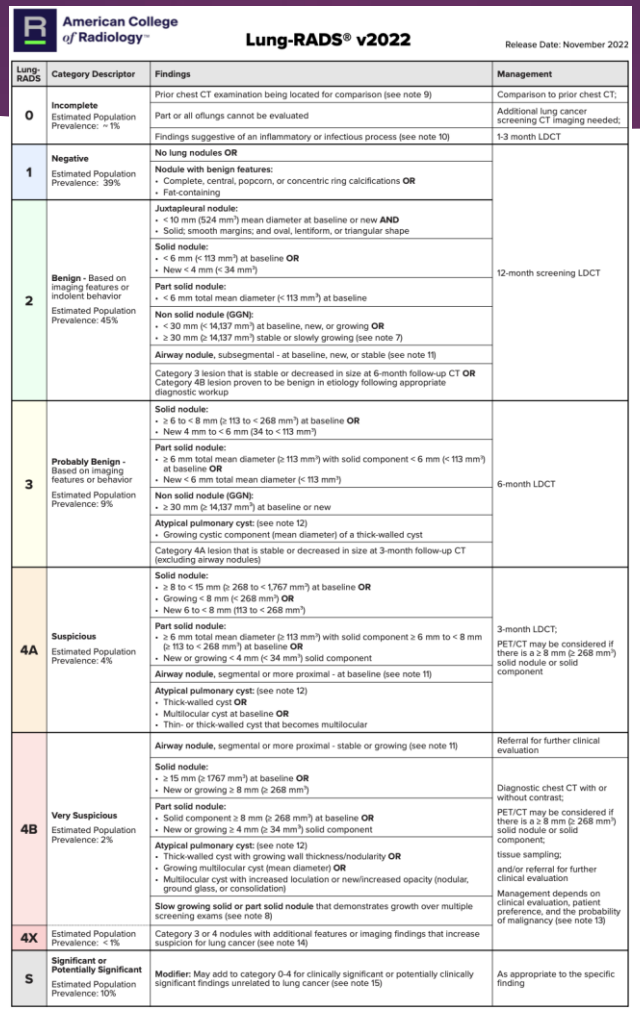
Reading LDCT

LUNG CANCER SCREENING BASICS

Objectives

- How did we get here?
- Discuss who gets screened
- Low dose protocol
- Reading the study
- Assigning a Lung RADs Category
- Troubleshooting

LUNG RADS



American College of Radiology™

Lung-RADS® v2022

Release Date: November 2022

Lung-RADS	Category Descriptor	Findings	Management
0	**Incomplete** Estimated Population Prevalence: ~ 1%	Prior chest CT examination being located for comparison (see note 9)	Comparison to prior chest CT;
		Part or all oflungs 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 mm^3) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	
		Solid nodule: • < 6 mm (< 113 mm^3) at baseline **OR** • New < 4 mm (< 34 mm^3)	
		Part solid nodule: • < 6 mm total mean diameter (< 113 mm^3) at baseline	
		Non solid nodule (GGN): • < 30 mm (< 14,137 mm^3) at baseline, new, or growing **OR** • ≥ 30 mm (≥ 14,137 mm^3) stable or slowly growing (see note 7)	
		Airway nodule, subsegmental - at baseline, new, or stable (see note 11)	
		Category 3 lesion that is stable or decreased in size at 6-month follow-up CT **OR** Category 4B lesion 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 mm^3) at baseline **OR** • New 4 mm to < 6 mm (34 to < 113 mm^3)	6-month LDCT
		Part solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component < 6 mm (< 113 mm^3) at baseline **OR** • New < 6 mm total mean diameter (< 113 mm^3)	
		Non solid nodule (GGN): • ≥ 30 mm (≥ 14,137 mm^3) at baseline or new	
		Atypical pulmonary cyst: (see note 12) • Growing cystic component (mean diameter) of a thick-walled cyst	
		Category 4A lesion 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 mm^3) at baseline **OR** • Growing < 8 mm (< 268 mm^3) **OR** • New 6 to < 8 mm (113 to < 268 mm^3)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) solid nodule or solid component
		Part solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm^3) at baseline **OR** • New or growing < 4 mm (< 34 mm^3) solid component	
		Airway nodule, segmental or more proximal - at baseline (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 - stable or growing (see note 11)	Referral for further clinical evaluation
		Solid nodule: • ≥ 15 mm (≥ 1767 mm^3) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm^3)	Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) 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)
		Part solid nodule: • Solid component ≥ 8 mm (≥ 268 mm^3) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm^3) 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

History of Lung Cancer Screening

- Lung Cancer is leading cause of cancer mortality in the US and Worldwide
- In 2023 there were 230,000 new cases with 127,000 deaths (21% of all cancer-related deaths)
- Majority of symptomatic individuals present with advanced stage disease
- National Lung Screening and NELSON (Dutch-Belgian) Trials
- Both demonstrated a decrease in mortality from lung cancer in screened individuals
- Early stage disease >> easier to treat and potentially cure

Who is Eligible for Screening?

- Greater than age 50
- Greater than or equal to 20 pack year smoking history
- Asymptomatic
- Able to tolerate definitive treatment for lung cancer

Low Dose Protocol

LOW-DOSE COMPUTED TOMOGRAPHY ACQUISITION, STORAGE, INTERPRETATION, AND NODULE REPORTING (Lung-RADS)[a-e]

Acquisition	Small Patient (BMI ≤30)	Large Patient (BMI >30)
Total radiation exposure	≤3 mSv	≤5 mSv
kVp	100–120	120
mAs	≤40	≤60
	All Patients	
Gantry rotation speed	≤0.5	
Detector collimation	≤1.5 mm	
Slice width	≤1.5 mm preferred for characterization of nodule consistency, particularly for small nodules[e]	
Slice interval	≤slice width; 50% overlap preferred for 3D and computer-aided detection (CAD) applications	
Scan acquisition time	≤10 seconds (single breath hold)	
Breathing	Maximum inspiration	
Contrast	No oral or intravenous contrast	
CT scanner detectors	≥16	

Reading LDCT

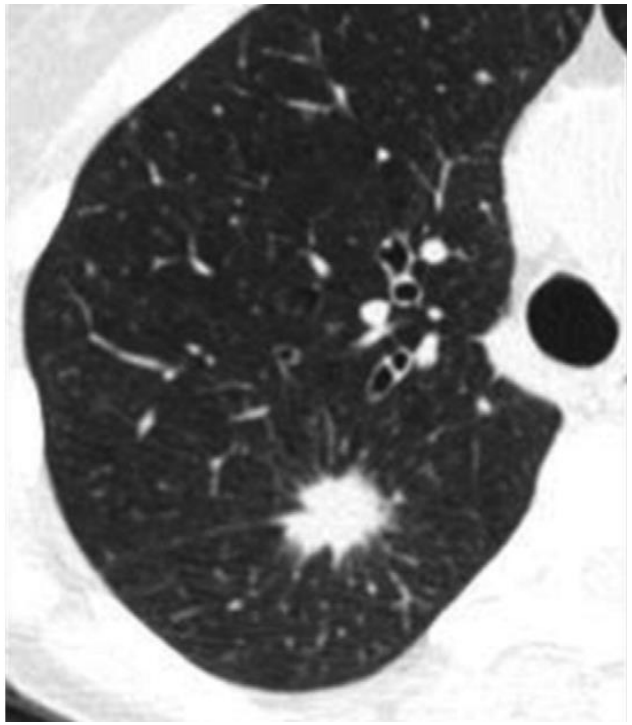
- Thin series bone algorithm and soft tissue
- Thick series soft tissue
- Coronal and sagittal reformats
- MIP series for improved nodule detection

Reading LDCT

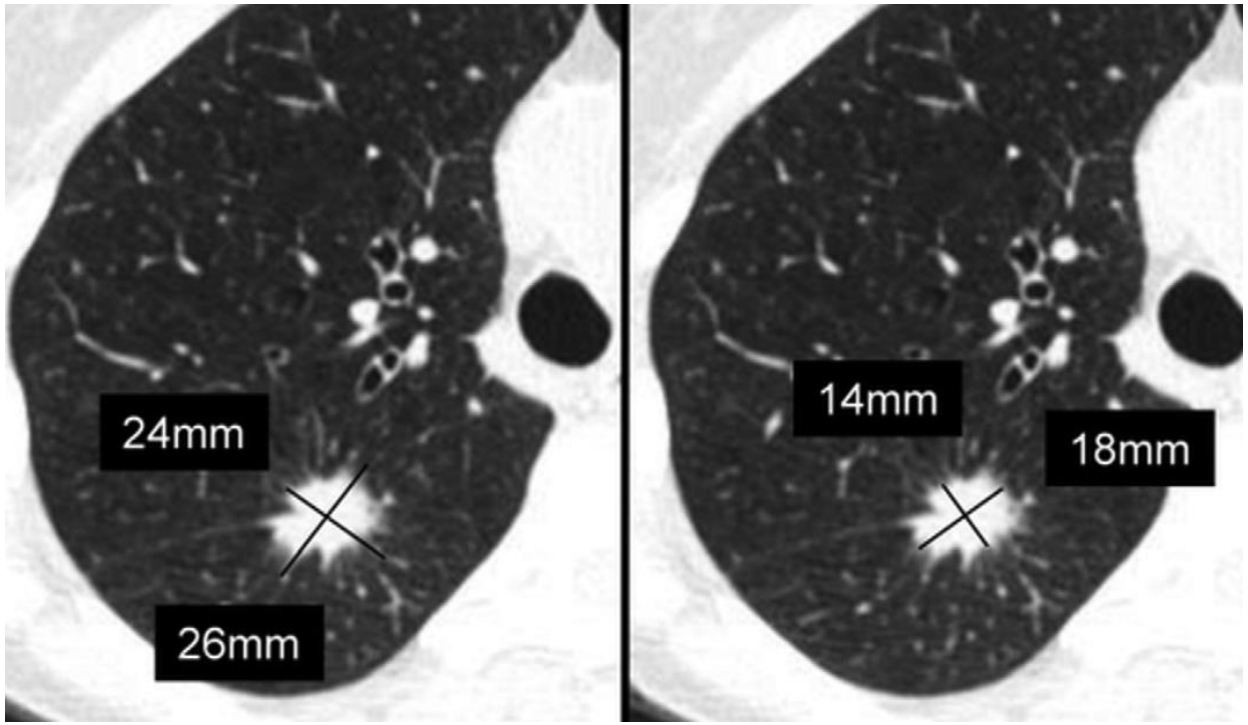
- Measuring nodules
  - Measure on lung windows
  - Measure long and short axis in same plane
  - Measurements are averaged and reported to the nearest decimal point
  - Reporting one dimension for round nodules is acceptable

Reading LDCT

- Solid nodules
- Obscure underlying lung architecture, vessels, bronchi, septae etc.



Reading LDCT



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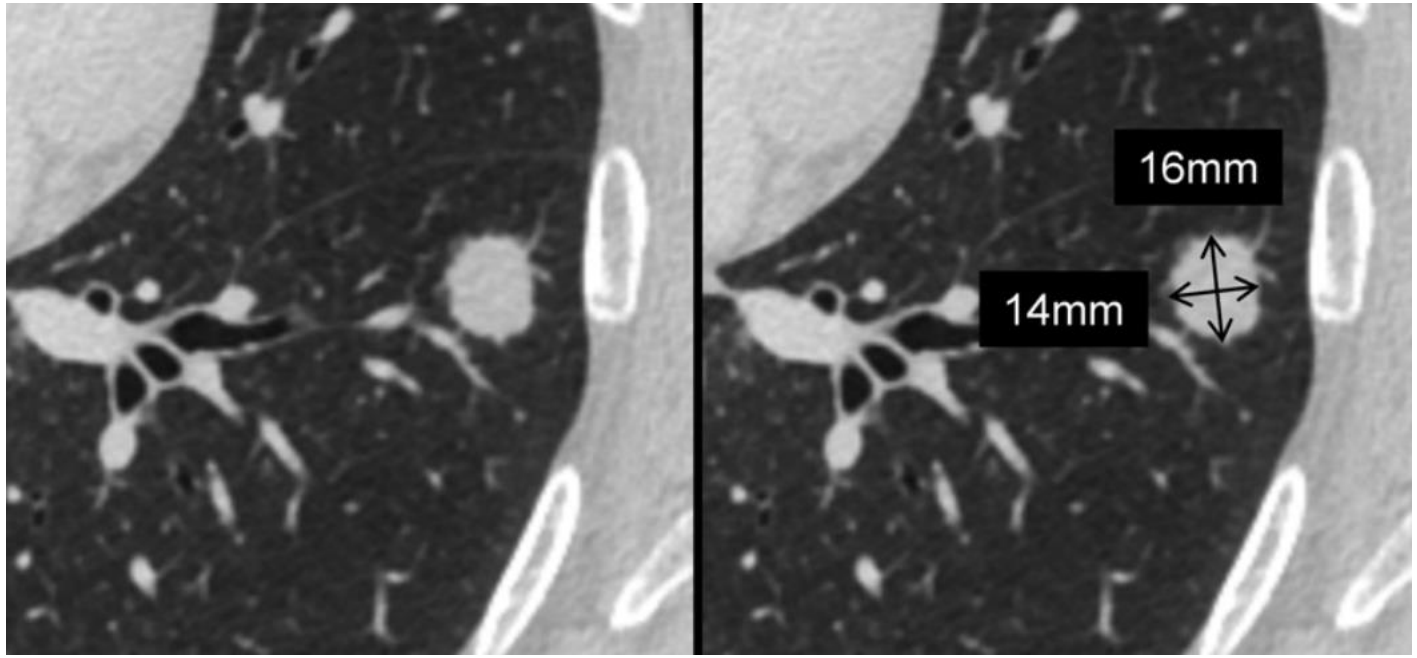
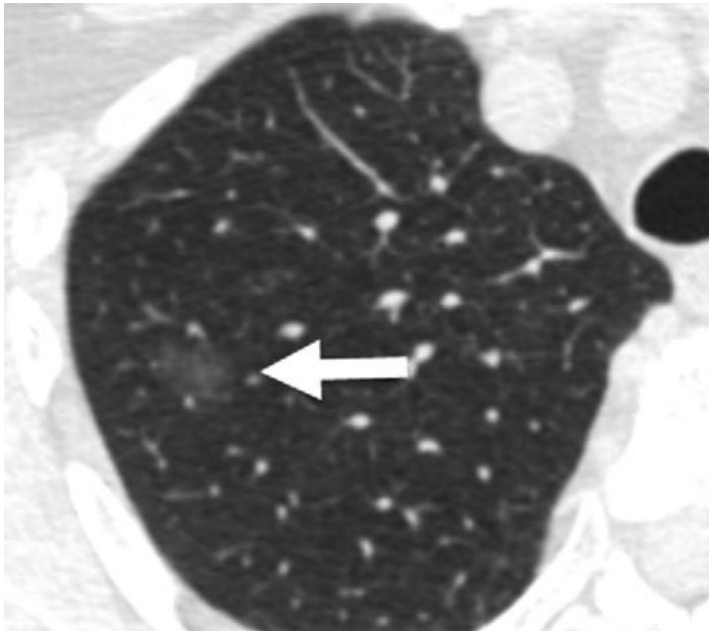


Reading LDCT

- Ground glass nodules
  - Do not obscure underlying structures



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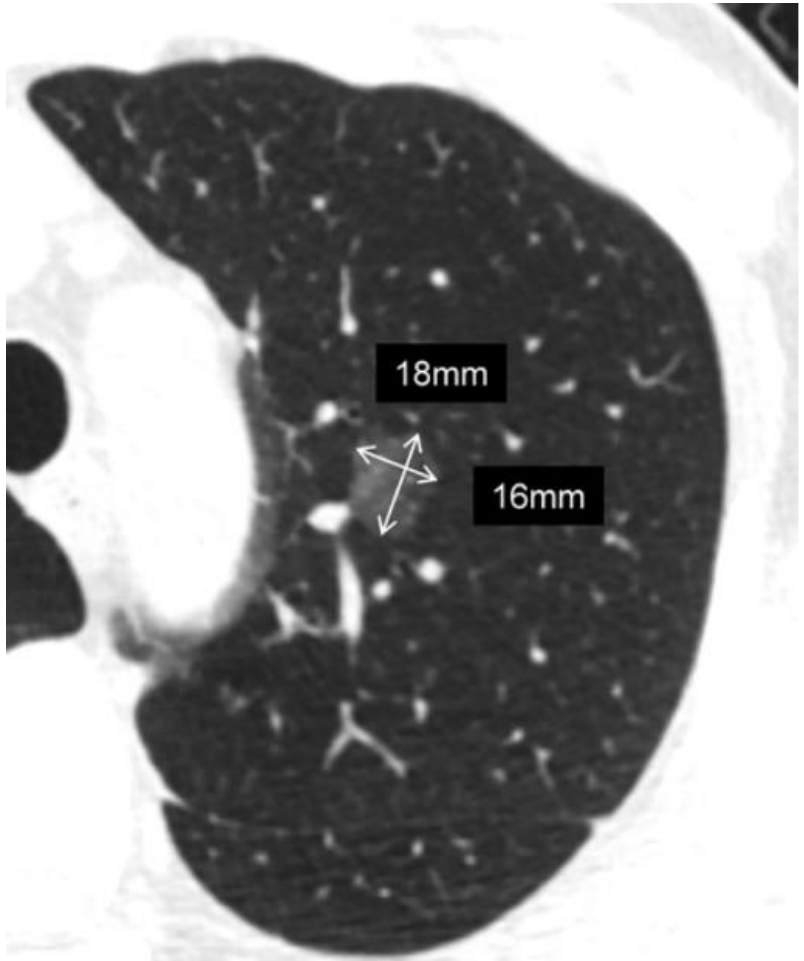
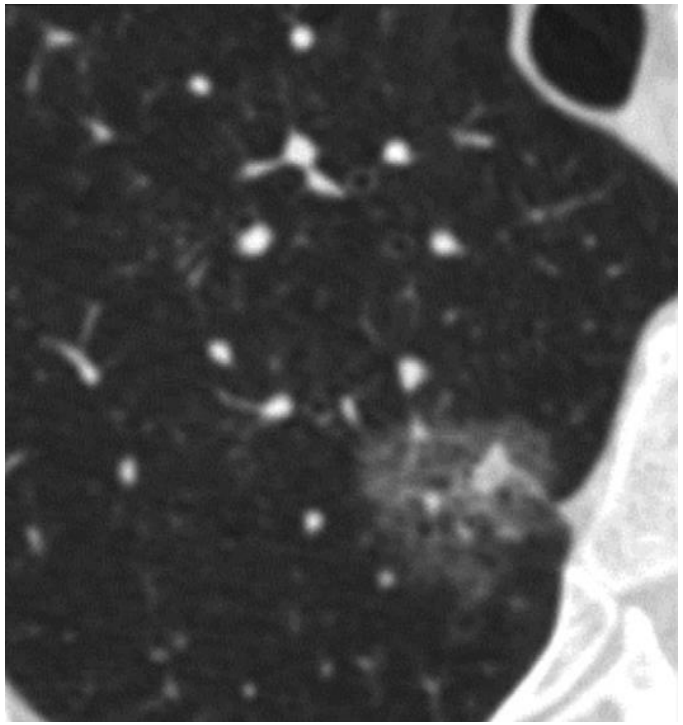


Reading LDCT

- Subsolid or Part Solid Nodules
  - Demonstrate both solid and ground glass components



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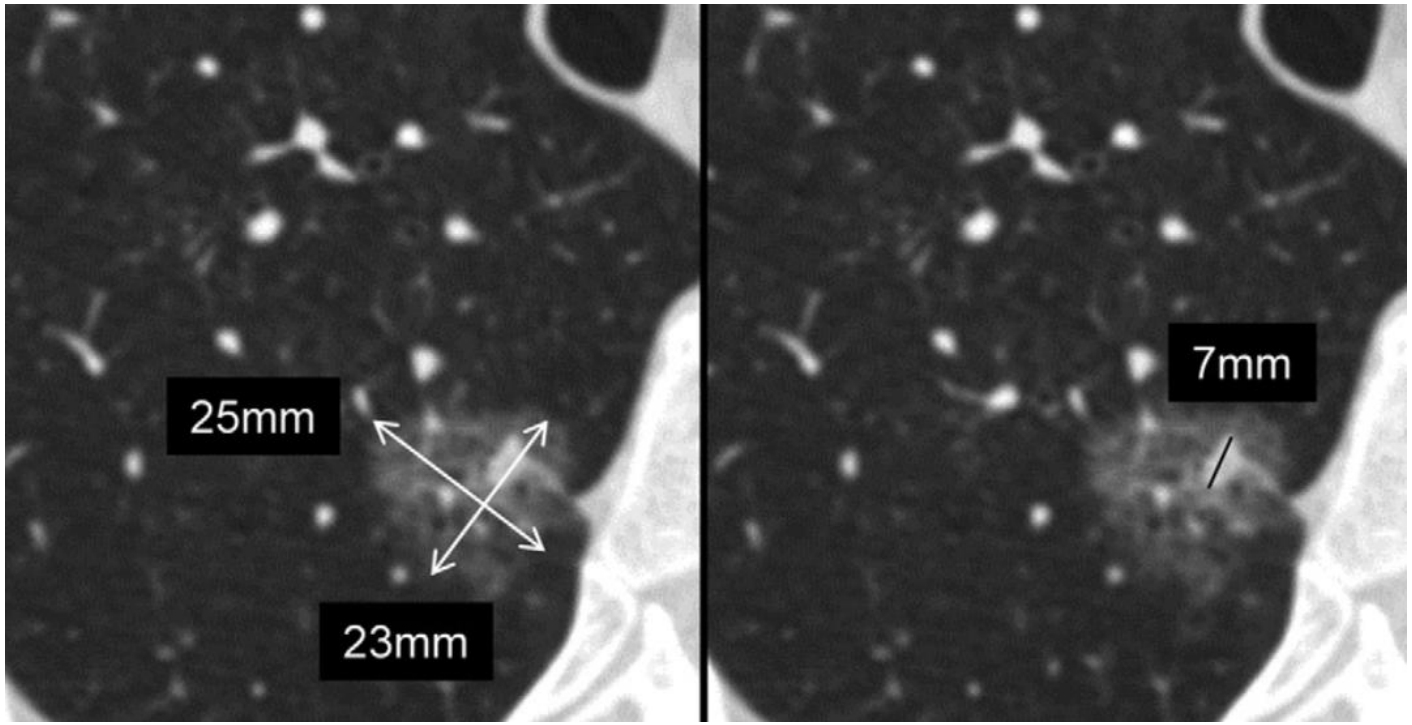
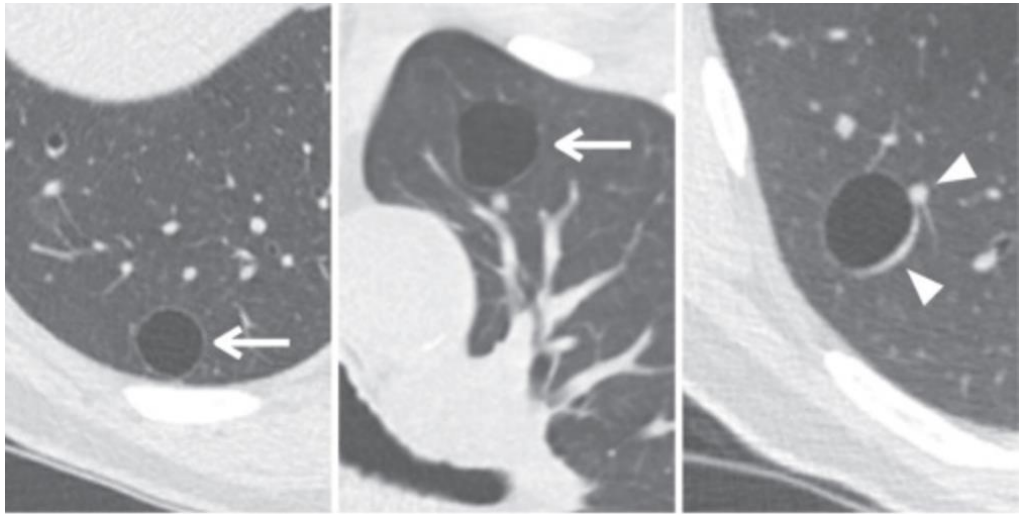


Reading LDCT

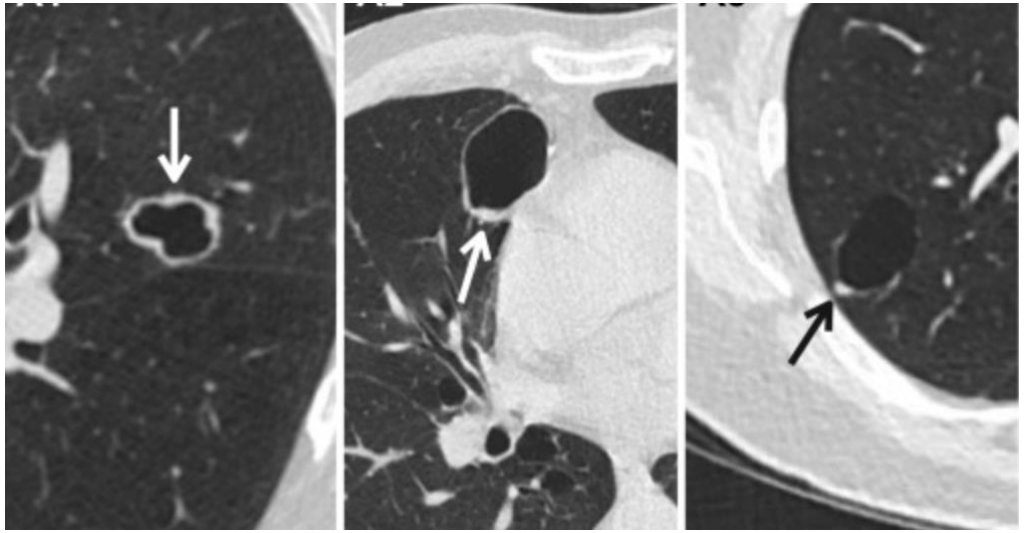
- Atypical Pulmonary Cysts
  - Up to 10% of lung cancers in high-risk patients may be associated with cystic precursors
  - Cystic lung cancers are more likely to be missed at initial screening
  - Thick-walled cysts
  - Multilocular cysts
  - Cysts with associated nodules

Reading LDCT



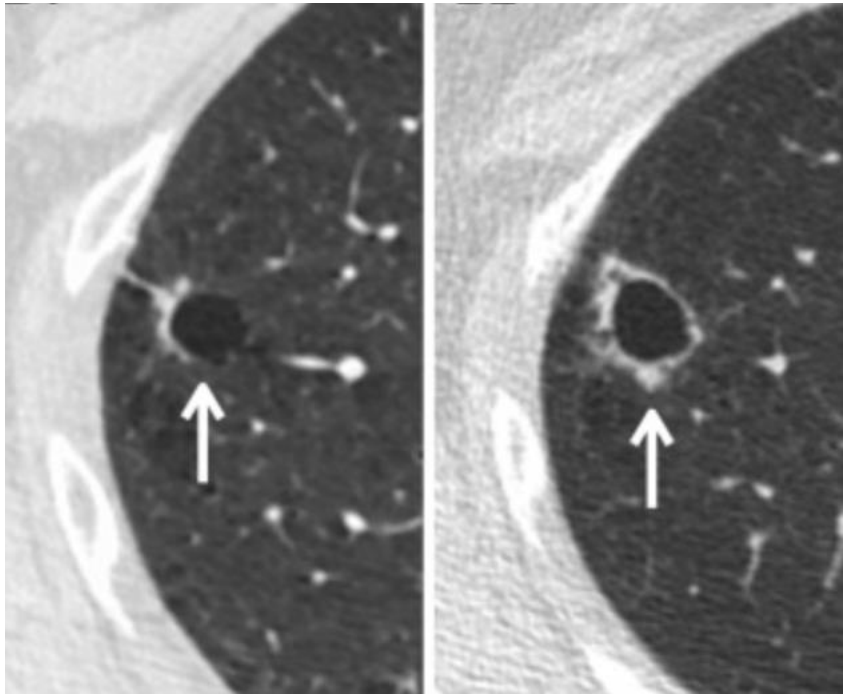
- Thin-walled cysts
- Not classified or managed according to Lung RADs

Reading LDCT



- Thick-walled cysts
- > 2mm thickness
- Circumferential, asymmetric or focal types

Reading LDCT

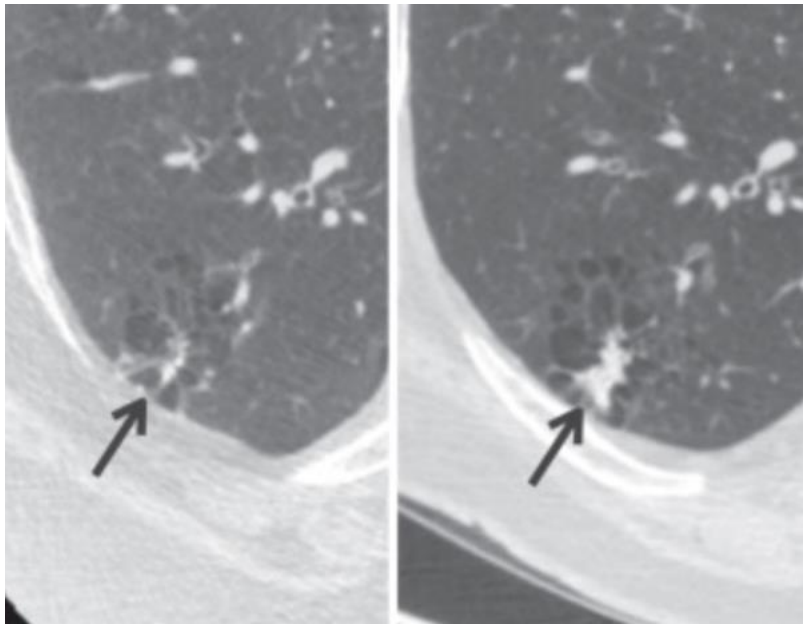


- Thick-walled cysts with increasing wall thickness and nodularity
- Category 4B

Reading LDCT

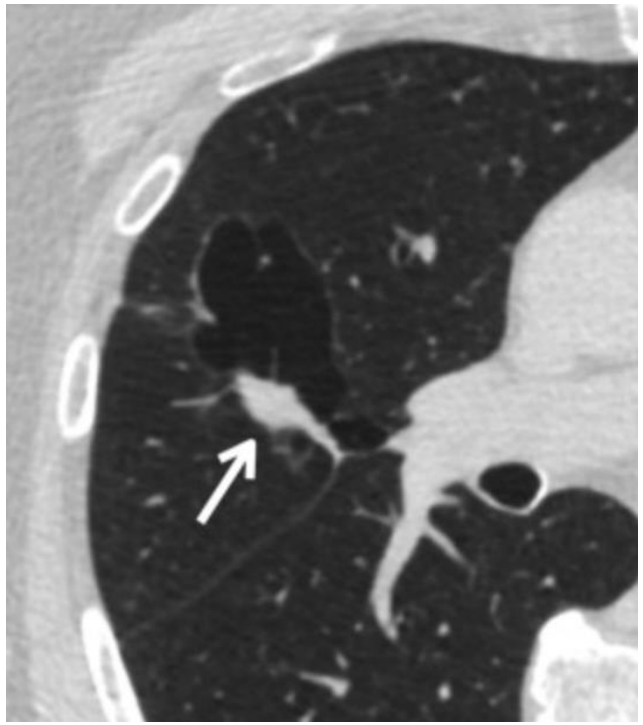
- Multilocular atypical cyst

Reading LDCT



- Growing solid component

Reading LDCT

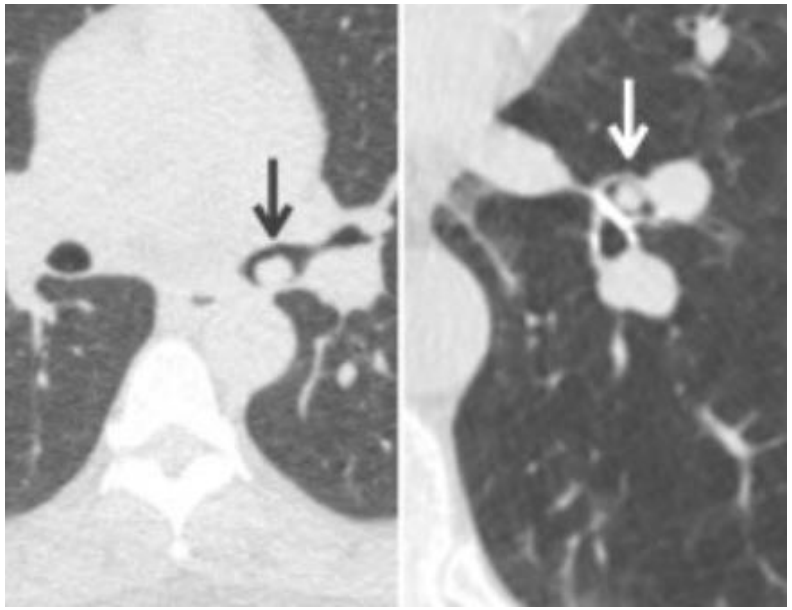


- Cysts with associated nodules
- Managed according to most suspicious feature

Reading LDCT

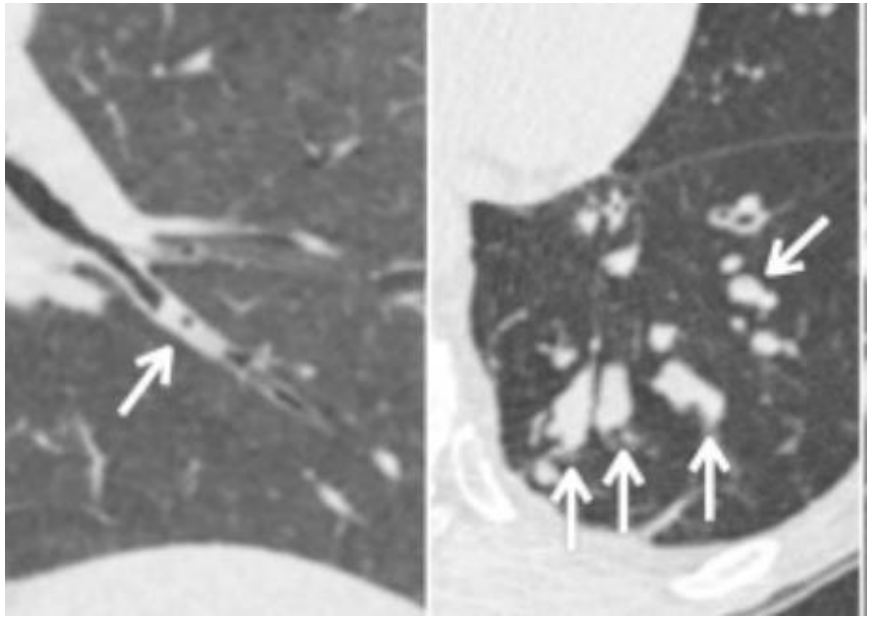
- Endobronchial abnormalities
  - Segmental or more proximal >> 4A >> 3-month LDCT
  - Subsegmental or tubular >> favor infection >> 0 or 2
  - Air within abnormality suggests secretions

Reading LDCT



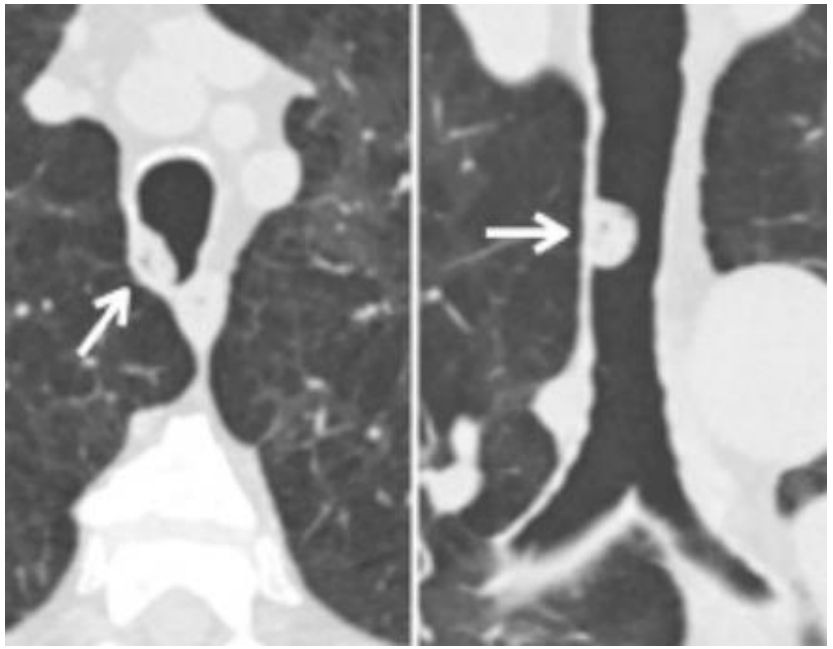
- Proximal airway nodules

Reading LDCT



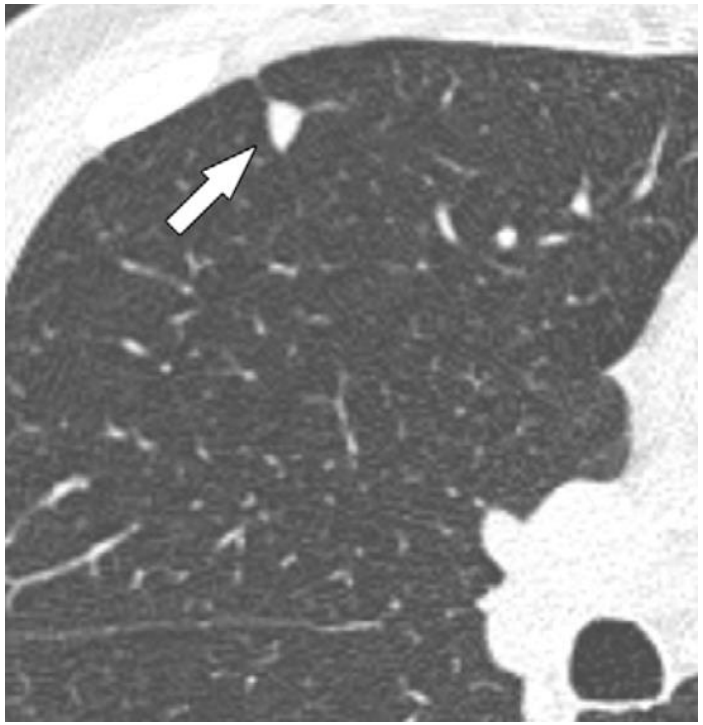
- Tubular filling defects suggest infection

Reading LDCT



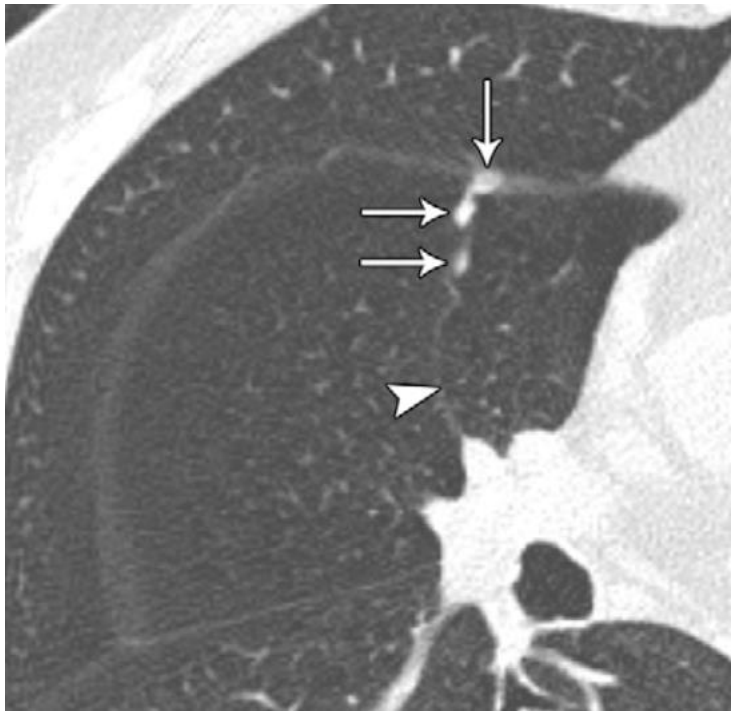
- More central secretions

Reading LDCT



- Perifissural/juxtapleural nodules
- Ovoid or triangular nodules adjacent to pleura, mediastinum or diaphragm
- Intrapulmonary lymph nodes
- Cat 2 finding

Reading LDCT



Lung RADs Categories

0	**Incomplete** Estimated Population Prevalence: ~ 1%	Prior chest CT examination being located for comparison (see note 9)	Comparison to prior chest CT;
		Part or all oflungs 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

Lung RADs Categories

1	**Negative** Estimated Population Prevalence: 39%	**No lung nodules OR**
		Nodule with benign features: • Complete, central, popcorn, or concentric ring calcifications **OR** • Fat-containing

Lung RADs Categories

2	**Benign -** Based on imaging features or indolent behavior Estimated Population Prevalence: 45%	**Juxtapleural nodule:** • < 10 mm (524 mm^3) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	12-month screening LDCT
		Solid nodule: • < 6 mm (< 113 mm^3) at baseline **OR** • New < 4 mm (< 34 mm^3)	
		Part solid nodule: • < 6 mm total mean diameter (< 113 mm^3) at baseline	
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		Airway nodule, subsegmental - at baseline, new, or stable (see note 11)	
		Category 3 lesion that is stable or decreased in size at 6-month follow-up CT **OR** Category 4B lesion proven to be benign in etiology following appropriate diagnostic workup	

Lung RADs Categories

3	**Probably Benign -** Based on imaging features or behavior Estimated Population Prevalence: 9%	**Solid nodule:** • ≥ 6 to < 8 mm (≥ 113 to < 268 mm^3) at baseline **OR** • New 4 mm to < 6 mm (34 to < 113 mm^3)	6-month LDCT
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		Atypical pulmonary cyst: (see note 12) • Growing cystic component (mean diameter) of a thick-walled cyst	
		Category 4A lesion that is stable or decreased in size at 3-month follow-up CT (excluding airway nodules)	

Lung RADs Categories

4A	**Suspicious** Estimated Population Prevalence: 4%	**Solid nodule:** • ≥ 8 to < 15 mm (≥ 268 to < 1,767 mm^3) at baseline **OR** • Growing < 8 mm (< 268 mm^3) **OR** • New 6 to < 8 mm (113 to < 268 mm^3)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) solid nodule or solid component
		Part solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm^3) at baseline **OR** • New or growing < 4 mm (< 34 mm^3) solid component	
		Airway nodule, segmental or more proximal - at baseline (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	

Lung RADs Categories

4B	**Very Suspicious** Estimated Population Prevalence: 2%	**Airway nodule**, segmental or more proximal - stable or growing (see note 11)	Referral for further clinical evaluation
		Solid nodule: • ≥ 15 mm (≥ 1767 mm^3) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm^3)	Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) 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)
		Part solid nodule: • Solid component ≥ 8 mm (≥ 268 mm^3) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm^3) solid component	
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		Slow growing solid or part solid nodule that demonstrates growth over multiple screening exams (see note 8)	

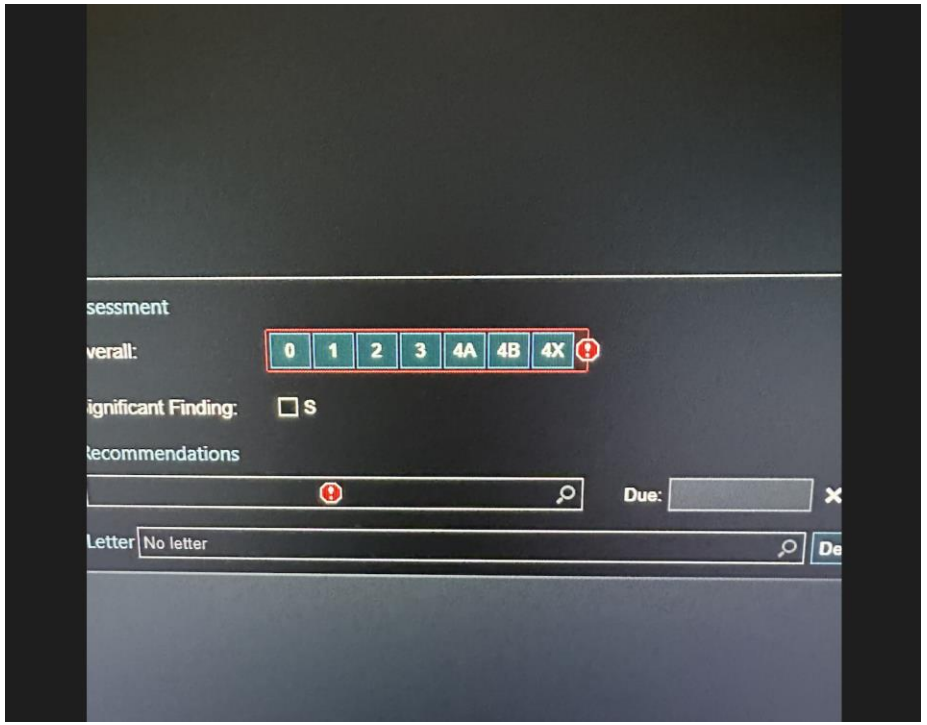
Lung RADs Categories

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)	

Lung RADs Categories

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

Reporting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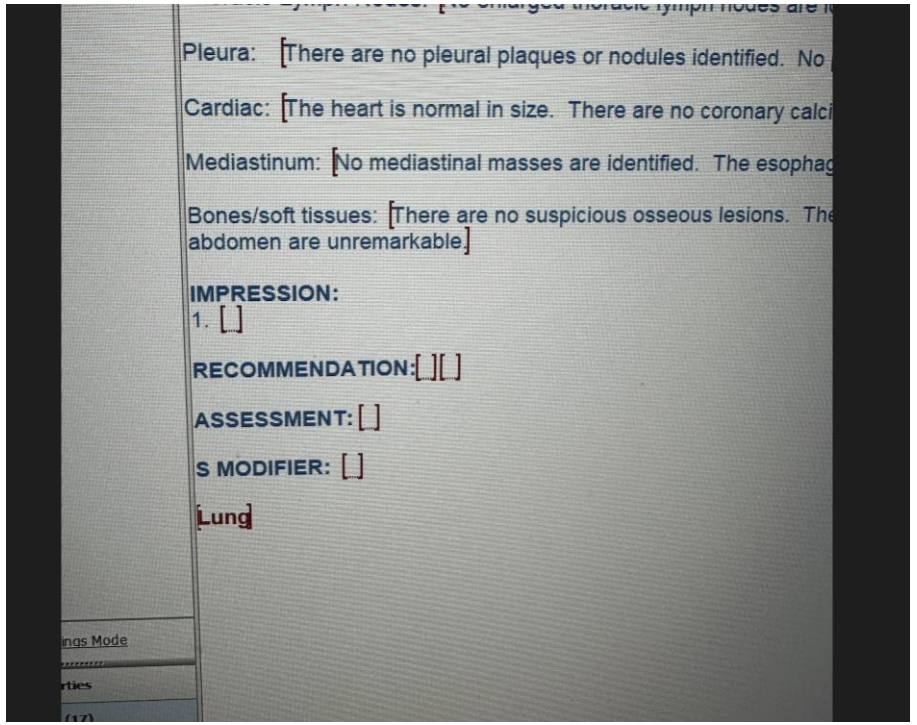
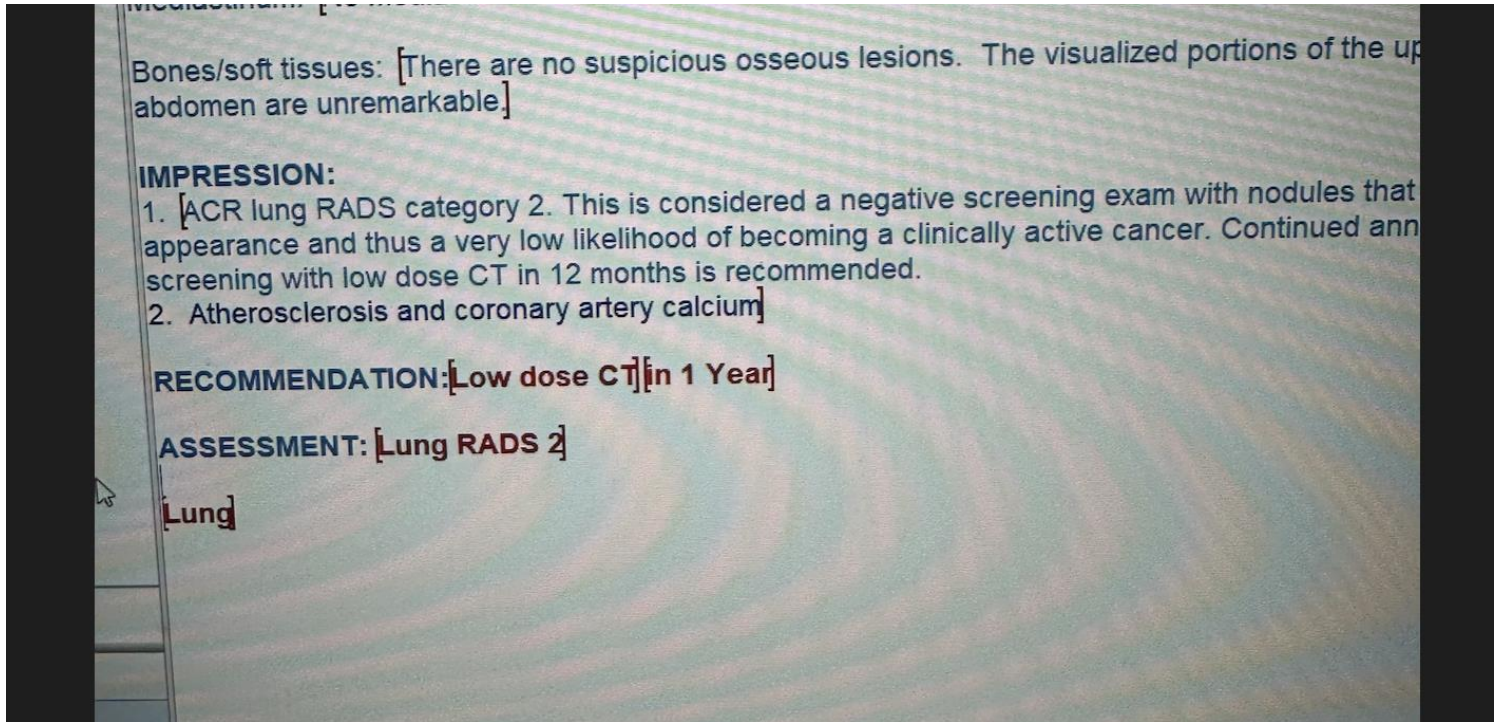

Pleura: [There are no pleural plaques or nodules identified. No
Cardiac: [The heart is normal in size. There are no coronary calci
Mediastinum: [No mediastinal masses are identified. The esophag
Bones/soft tissues: [There are no suspicious osseous lesions. The
abdomen are unremarkable]
IMPRESSION:
1. [ ]
RECOMMENDATION:[ ][ ]
ASSESSMENT: [ ]
S MODIFIER: [ ]
[Lung]

Reporting



Bones/soft tissues: [There are no suspicious osseous lesions. The visualized portions of the up
abdomen are unremarkable.]

IMPRESSION:
1. [ACR lung RADS category 2. This is considered a negative screening exam with nodules that
appearance and thus a very low likelihood of becoming a clinically active cancer. Continued ann
screening with low dose CT in 12 months is recommended.
2. Atherosclerosis and coronary artery calcium]

RECOMMENDATION:[Low dose CT][in 1 Year]

ASSESSMENT: [Lung RADS 2]

[Lung]

Important Reporting Tidbits

- Nodule growth defined as increase in mean diameter > 1.5 mm in 12-month period
- Slow growing solid or part-solid nodules not meeting size threshold are suspicious and should be classified as 4B
- Slow growing GGN should not be reclassified until they meet the size threshold for higher category
- There is no “return to annual screening”. Follow-up studies should serve as new baseline.